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The Application of Statistical Techniques to the Palynofloral Analysis Ofthe Coker Formation (Upper Cretaceous), Western Alabama (Volumes I and II).

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THE APPLICATION OF STATISTICAL TECHNIQUES TO THE PALYNOFLORAL ANALYSIS OF THE COKER FORMATION (UPPER CRETACEOUS), WESTERN ALABAMA

VOLUME I

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ABSTRACT

Two statistical techniques were applied to the relative abundance of 180 palynomorph taxa from two cores of the Coker Formation (Upper Cretaceous) in western Alabama, for the purposes of:

1) determining if greater variation was introduced during the physical and chemical preparation of palynological samples or during slide preparation; and,
2) removing from biostratigraphic consideration those taxa whose relative abundance was controlled by changes in lithology.

Variance components for samples prepared from the same lithologic unit and for slides made from the same sample were obtained for each taxon using a nested analysis of variance in a completely randomized design. The variance component for slides made from the same sample was the larger for all but fourteen miospore taxa. It was concluded that greater variation was displayed among slides made from the same sample than among samples prepared from the same lithologic unit. Slide-to-slide variation could be reduced by refining the procedures employed in slide preparation, which would create more homogeneous experimental units; or its effect could be minimized by counting more slides per sample, which would reduce the standard error of the mean relative abundance of miospore taxa.

A backward elimination regression technique was applied to the frequency of occurrence of miospore taxa in each core, to identify

those miospores whose relative abundance was controlled by lithologic changes (represented by median grain size and sorting coefficient) and those controlled by changes in time (represented by the linear, quadratic and cubic effects of depth in the core). On the basis of analyses performed on species which were lithologically controlled, the following conclusions were reached:

1) poorly sorted sediment contains a greater proportion of these species than does well sorted sediment;
2) an optimum median grain size exists for use in palynofloral analysis, which has no control over the relative abundance of these species; and,
3) lithologic control of miospores could be characterized regardless of morphologic similarities and differences among them.

The concurrent ranges of twenty-one miospore species whose relative abundance was controlled only by changes in depth in both cores were used to establish three florizones. The florizones were recognized in both cores, and provided the basis for biostratigraphic correlation of the cores.

A high degree of geographic variation in relative abundance of miospore taxa was noted, but the reason for this variation could not be determined.

Five reworked miospores were identified, which suggested the Coker Formation in western Alabama is, in part, derived from rocks of the Pennsylvanian System.

I. INTRODUCTION

Two statistical analyses were performed on the frequency of occurrence of 180 palynomorph taxa recovered from two cores of the Coker Formation (Upper Cretaceous) in western Alabama. The first analysis involved the calculation of variance components for two sources of variation associated with laboratory procedures: the variation among slides made from the same sample, and among samples prepared from the same lithologic unit. These variance components were obtained from a nested analysis of variance in a completely randomized design, performed on the frequency of occurrence of each palynomorph taxon. A comparison was made of the relative size of these variance components, as this comparison indicated whether greater variation was introduced into this palynological investigation partially as a result of the physical and chemical preparation of samples, or as a result of slide preparation. The second analysis involved the use of a backward elimination regression technique to separate those miospore taxa whose relative abundance was partially or wholly controlled by selected grain size parameters, from those controlled by depth. The species whose relative abundance was controlled only by changes in depth were considered more reliable biostratigraphic indicators, and florizones were established on the basis of their concurrent ranges.

The Coker Formation, from which samples were obtained, is the basal formation of the Tuscaloosa Group, and has been assigned a

Cenomanian Age by Berry (1919) on the basis of dicotyledonous plant remains.

The regression technique presented for "filtering" palynological data evaluated the effect of changes in depth and lithology on the frequency of occurrence of miospore taxa. Changes in depth are related to changes in time through the Law of Superposition, and changes in lithology most likely reflect changes in transportational and depositional processes. It is unlikely that the lithologic changes are affected by conditions which prevailed at the site of miospore production, after deposition of miospores, or during the sampling and analytical procedures associated with their recovery. The following review illustrates that many of the sources of variation which create differences among palynological assemblages do so under one of the conditions mentioned above, and can be recognized through changes in climatic provinces (regions), changes in ecologic subdivisions of climatic provinces (environments), or changes in lithology.

Sources of variation in palynology

The basis for biostratigraphic correlation is evolution of organisms, but the effects of factors other than those related to the evolution of miospore species are not yet fully understood. Tschudy (1964) is of the opinion that facies changes with a depositional basin do not create differences among palynological assemblages because the miospores under consideration are not indigenous to the basin. However, de Jekhowsky (1963a) listed turbulence, the chemical character of the environment, and the rate of deposition of inorganic particles within a basin as some of the factors which controlled the content of

palynological assemblages. Recent studies on miospore deposition have begun to provide information on the effect of those sources of variation which have an effect:

1) at the site of miospore production;
2) during transportation and deposition of miospores;
3) after deposition of the miospore assemblage; and,
4) during sampling and analytical procedures involved with the recovery of miospores.

Variability introduced at the site of miospore production. Many of the sources of variation which effect the miospore assemblage at the site of miospore production are related to the ecological requirements of the plants producing the miospores, including changes in climate, plant succession and local weather conditions. The variation in the number of miospores produced by different species, and the presence of teratological forms are related to genetic factors.

The primary ecologic factor which controls plant distribution is climate, and maps of major vegetation types and major climatic zones are quite similar (Oosting, 1956, p. 271). The control of climate on Mississippian miospore assemblages was described by Sullivan (1965, 1967), who recognized three miospores suites differentiated in Mississippian rocks of the Northern Hemisphere: the Grandispora, Monilospora and Kazakhstan suites. By superimposing previously established Osage-Springer paleolatitudes on a map showing the distribution of these suites, Sullivan (1967) concluded that the Grandispora Suite occupied a tropical zone ranging from 20° North to 20° South latitude; the Monilospora Suite occupied a more temperate zone, ranging from 20° North to 40° North latitude; and the Kazakhstan Suite, although

localized, was restricted north of 40° North latitude. The boundaries between these suites were not stationary throughout the Mississippian Period, and Sullivan (1965) indicated that there was a northward migration of the Grandispora Suite at the end of the Late Mississippian Period.

Couper (1964) presented several range charts which showed differences in the distribution of eighteen morphologic groups of Cretaceous miospores for several geographic and climatic regions. Saccate miospores are generally found in excess of ten per cent of the total assemblage in Cretaceous rocks from present day north and south temperate regions, but less than one per cent in assemblages from Cretaceous rocks of tropical and sub-tropical regions. Couper's (1964) work suggested that most of the elements of Cretaceous gymnosperm floras of the Northern and Southern Hemispheres were as widely separated, botanically, during the Cretaceous Period as they are today.

Within climatic regions, differences among palynologic assemblages can be attributed to ecologic requirements other than climate; e. g., plant succession and variations in local weather conditions.

Habib (1966) recognized five palynofloral assemblages in the lower Kittanning Coal of western Pennsylvania. Where the coal seam is directly overlain by rocks of marine origin, there is a definite pattern in the spatial arrangement of these assemblages, with the number of species decreasing upward in the seam. Comparing the assemblages in the lower Kittanning Coal with assemblages from Holocene migrating peat bodies in southwestern Florida, Habib (1966) concluded that changes in palynomorph assemblages came about in response to changes in salinity; that is, in response to transgressing marine conditions, competi-

tion among species increased, which led to a decrease in the number of species. Similarly, palynological investigations of the upper part of the Coffeyville Formation (Pennsylvanian) of Oklahoma by Upshaw and Hedlund (1967) indicated that an increase in the abundance of saccate miospore producing plants prior to the end of coal swamp conditions reflected plant succession in that area.

Davis (1967) pointed out that differences among palynological assemblages may reflect variations in local weather conditions, as these variations effect the vigor of flowering and miospore production for a given species.

The degree to which the composition of a miospore assemblage reflects the composition of the vegetation which produced that assemblage may be highly distorted, as some species produce many miospores, and others produce few miospores. Hansen (1949) compared the composition of a Douglas fir-white oak community in the Oregon Coast Range with the miospore composition of bryophytic polsters from the same area. Douglas fir pollen constituted 76.39 per cent of all pollen observed, but Douglas fir trees accounted for only 42 per cent of the community in abundance, and 68 per cent of the community in basal area. White oak was under-represented in the pollen record when compared to its role in the forest community. In addition to over- and under-representation of pollen, Hansen recorded nine species represented by pollen which did not appear in his sample quadrats, and eight species not represented by pollen but were present in the quadrats.

The presence of teratological forms in palynology has been investigated by Wilson (1963, 1965) and Skarby (1968). Wilson (1963) indicated that 96.9 per cent of Picea glauca miospores were of the normal

type, and variants ranged from forms with reduced sacci to monosaccate forms. According to Wilson (1965), only 87.7 per cent of Pinus flexilis pollen grains were of the normal type, and variants, which are distally monosaccate, proximally monolete or trilete, or possess four equatorial sacci, were observed. Skarby (1968) considered many of the genera described from the Senonian Stage of Europe to be abnormal forms of the genus Extratriporopollenites, with the most common abnormalities being irregularities in shape, aberrant numbers of apertures, extremely thick wall layers, and irregularly developed apertures. Recognition of teratological forms is particularly important for periods during which certain groups were rapidly evolving, not only to avoid taxonomic confusion, but to clarify phylogenetic relationships.

The sources of variation attributed to factors operating at the site of miospore production are presented in Table I, together with the factors which control these sources, and the possible level at which the sources might be recognized in the geologic record.

Variability introduced during transportation and at the depositional site. Chaloner and Muir (1968) pointed out that miospores contained in sediments and sedimentary rocks are "biological dropouts," as they have failed to fulfill their role in reproduction. Therefore, a large per cent of the miospores produced can be considered as sedimentary particles of organic composition, subject to the same factors which govern the distribution of detrital particles. Included among these factors are the distance transported, the intensity of the transporting medium and the mode of transport. According to de Jekhowsky (1963a), these factors influence the number of individual miospores

TABLE I

SOURCES OF VARIATION OPERATING AT THE SITE OF MIOSPORE PRODUCTION, THEIR CONTROLLING FACTORS AND THEIR LEVEL OF RECOGNITION

<table>
<tr><th>SOURCE OF VARIATION</th><th>CONTROLLING FACTOR</th><th>LEVEL OF RECOGNITION</th></tr>
<tr><td>CLIMATE</td><td rowspan="3">ECOLOGICAL REQUIREMENTS OF PRODUCING PLANTS</td><td>REGIONAL CHANGES</td></tr>
<tr><td>PLANT SUCCESSION</td><td rowspan="3">ENVIRONMENTAL CHANGES</td></tr>
<tr><td>VARIATIONS IN LOCAL WEATHER CONDITIONS</td></tr>
<tr><td>VARIATIONS IN MIOSPORE PRODUCTION</td><td rowspan="2">GENETIC REQUIREMENTS OF PRODUCING PLANTS</td></tr>
<tr><td>TERATOLOGICAL FORMS</td><td></td></tr>
</table>

deposited per unit of time, the number deposited per unit volume of sediment, and the relative abundance of a given species.

Buell (1947) investigated the deposition of miospores produced by Pinus echinata, and concluded that the amount of pollen settling to the ground decreased rapidly with increased distance from the source. Carroll (1943) stated that species of pollen which occur in small percentages are usually transported over considerable distances to the site of deposition. These observations were confirmed by Janssen (1966).

The resistance of miospores to destruction during transportation differs with the intensity of the transporting medium. Cross (1964) pointed out that modification of miospores by defacement or degradation may result in differences in the appearance of the same type of palynomorph.

Although no quantitative studies have been published on the effect of mode of transport on miospores, Muller (1959), and Cross, Thompson and Zaitzeff (1966) suggested that transportation of miospores by water has a greater effect on the ultimate composition of an assemblage than does transportation by air.

At the depositional site, the primary factors affecting miospore deposition are: 1) differential flotation of miospores, 2) the physical characteristics (including the shape, size and depth) of the depositional basin, and 3) turbulence in the medium of deposition.

Erdtman (1943) compared the miospore spectra of modern sediments with those of contemporaneously formed peats, and concluded that differential flotation does not constitute a serious source of error in miospore analysis. However, Hopkins (1950) conducted a series of

laboratory experiments on differential flotation and deposition of selected coniferous and deciduous pollen, and found that, although the rate of settling of bladdered forms was less than that for non-bladdered forms, the rate of settling was species specific. In bladdered forms, the rate of settling was inversely proportional to the relative size of the bladders, and was dependent, to some degree, on the ability of water to replace air in the bladders.

Davis (1967) measured the number of miospores deposited per unit area in three New England lakes of differing sizes over a two year period, and found that yearly miospore accumulation rates per unit area were proportional to the size of the lake. According to Davis (1967), relatively little of the miospore composition of lake sediment is derived from a vertical pollen rain, and most of the pollen originates in the vegetation growing within a few kilometers of a lake, being blown horizontally through, or just above, the vegetation growing along the shores. Therefore, the amount of pollen deposited on a lake surface decreases with increasing distance from shore. If homogeneous mixing of pollen and lake water is achieved prior to deposition, the amount of pollen deposited per unit area, during a given time interval, would decrease with an increase in the size of the depositional basin.

Janssen (1966) suggested that miospore assemblages reflect three types of pollen rain: 1) localized; 2) extralocal; and 3) regional. Localized pollen rain is derived from plants growing at, or very near, the sample location. Extralocal pollen rain consists of miospores from vegetation growing adjacent to the sampling area, but which is not extensive in areal distribution. Regional pollen rain is derived

over long distances, and is characterized by pollen types whose distribution and abundance are controlled solely by climate. It is the constituents of the regional pollen rain which provide the most reliable basis for long-range correlation, and Janssen stated that samples from larger lakes reflect a more uniform regional pollen rain than do samples from smaller lakes, while Davis, Brewster and Sutherland (1969) recommended the use of samples from the deeper parts of medium size lakes for the best representation of regional pollen rain. According to Davis et al., (1969) small lakes over-represent local vegetation and large lakes are subject to erosion and redeposition of pollen by wind-created waves and currents, which obscure events otherwise represented in the regional pollen rain.

Davis, Brewster and Sutherland (1969) noted that, for each of the six Wisconsin lakes included in their study, deep water and shallow water samples were more homogeneous within themselves than the entire group of samples from any one lake. A correlation between sample depths and departures from the mean pollen spectrum led them to conclude that a process was operating in shallow portions of a basin, inversely proportional to water depth, which caused the pollen spectra of shallow water sediments to deviate significantly from the mean pollen spectra of the lakes. Therefore, regional pollen rain was best represented in samples from deeper portions of the depositional basin.

There are no publications presently available in which the shape of the depositional basin on miospore deposition has been investigated.

Investigations by de Jekhowsky (1963a) suggested that turbulence of the medium in which miospores are deposited may create differences

among palynological assemblages by affecting the relative concentration of organic and inorganic grains, as well as creating differences in the chemical environment, which may selectively destroy some forms.

The sources of variation associated with transporting and depositional processes probably manifest themselves in changes from one lithologic unit to another. Therefore, the ability to characterize changes in lithology would permit evaluation of the effect of transporting and depositional processes on the composition of miospore assemblages. These sources of variation are presented in Table II, along with their controlling factors and the level at which they can be recognized in the geologic record.

Variation introduced after miospore deposition. In addition to biological activity, including the work of burrowing organisms and bacterial and/or fungal corrosion, and chemical activity, including diagenetic and metamorphic processes, miospores are subject to possible reworking, recycling and stratigraphic leakage. All of these factors can operate to produce post-depositional changes in the miospore assemblage.

Nichols (1967) reported that the disturbance of sediment by burrowing organisms not only blurs the registration of events in the palynological record, but may physically break some grains. Although the activities of burrowing organisms help offset minor fluctuations in miospore assemblages within a vertical sequence, it mixes time units, thus obscuring changes with time.

Elsik (1966) recognized three distinct patterns of degradation in the exine of miospores from Mississippian, Lower Cretaceous and Tertiary deposits: 1) simple, circular to slightly irregular perfora-

TABLE II

SOURCES OF VARIATION OPERATING DURING TRANSPORTATION AND DEPOSITION OF MIOSPORES, THEIR CONTROLLING FACTORS AND THEIR LEVEL OF RECOGNITION

SOURCE OF VARIATION	CONTROLLING FACTOR	LEVEL OF RECOGNITION
DISTANCE TRANSPORTED	FACOTRS ASSOCIATED WITH TRANSPORTING PROCESSES	LITHOLOGIC CHANGES
INTENSITY OF TRANSPORTING MEDIUM		
MODE OF TRANSPORTATION		
DIFFERENTIAL FLOTATION OF MIOSPORE SPECIES	FACTORS ASSOCIATED WITH DEPOSITIONAL PROCESSES	
PHYSICAL CHARACTERISTICS OF DEPOSITIONAL BASIN		
TURBULENCE IN THE MEDIUM OF DEPOSITION		

tions; 2) wedge-shaped perforations arranged in rosettes of four or more wedges; and, 3) meandering, branching grooves. These degradation patterns were attributed by Elsik to enzymatic activity of fungi, as the patterns are distinct and repeated on various miospore types. All three degradation patterns were observed more frequently on laevigate miospores than on any other morphological type, suggesting that certain miospores may be selectively removed or altered beyond recognition by the destructive activity of bacteria and fungi.

The chemical and thermal alterations which generally accompany metamorphic processes may selectively remove certain categories of palynomorphs. Smith and Saunders (1970) reported that Acritarchs are never found in rocks reflecting metamorphic processes as high as green-schist facies, but Carrington (1970) recovered an identifiable miospore assemblage from a green-schist facies of the Jemison Formation (Lower Devonian) of Alabama.

Recycling and stratigraphic leakage of miospores can be recognized by a number of criteria, according to Wilson (1964). These are the presence of palynomorphs which: 1) are of differing geologic ages; 2) react differently to biological stains; 3) exhibit differential preservation; and, 4) are of marine origin, but are contained in rocks deposited in fresh water.

Davis (1968) investigated the causes and effects of erosion, resuspension and redeposition of miospores in Frains Lake, Michigan. Two-to-four times as many miospores/cm^2/year were deposited in traps suspended above the lake bottom than were recovered from core samples of the lake sediment. Davis (1968) concluded that eighty per cent of the miospores contained in the traps resulted from redeposition. Re-

working of miospore-bearing sediment was attributed to seasonal water circulation in the lake, as high rates of miospore redeposition corresponded to periods of water circulation. During periods of thermal stratification, the rate of miospore reworking was extremely low.

Recognition of the effect of the sources of variation operating after miospore deposition depends to a large extent on qualitative appraisals or indirect reasoning, as these sources tend to completely remove, or selectively alter, morphological types in the assemblage. These sources of variation, their controlling factors and level of recognition are presented in Table III.

Variation related to sampling and analytical procedures. Although the variation introduced during the procedures involved in the recovery of miospores is often overlooked, its importance cannot be overemphasized. As Cross (1964, p. 12) noted, "One of the most significant weaknesses in modern palynological studies is the difference in results derived from the study of the same samples or similar samples by different laboratories. Many of the differences are the result of processing the samples in different ways." In addition to introducing variation during the chemical treatment of samples, variation can be observed within slides, among slides prepared from the same sample, and among samples taken from the same lithologic unit. In the absence of a consistent taxonomy, palynologic investigations which involve comparisons with assemblages reported in the literature are subject to personal bias.

The chemical maceration techniques used on palynologic samples are

TABLE III

SOURCES OF VARIATION OPERATING AFTER MIOSPORE DEPOSITION, THEIR CONTROLLING FACTORS AND LEVEL OF RECOGNITION

SOURCE OF VARIATION	CONTROLLING FACTOR	LEVEL OF RECOGNITION
BOTTOM-BURROWING ORGANISMS	BIOLOGICAL ACTIVITY	THE ABILITY TO RECOGNIZE THESE SOURCES OF VARIATION AND THEIR CONTROLLING FACTORS IS LARGELY DEPENDENT UPON THE EXPERIENCE OF THE INVESTIGATOR
BACTERIAL AND/OR FUNGAL CORROSION		
DIAGENESIS	CHEMICAL AND THERMAL PROCESSES	
METAMORPHISM		
REWORKING	SEASONAL WATER CIRCULATION (AMONG OTHERS)	
RECYCLING	EROSION TRANSPORTATION AND DEPOSITION OF SEDIMENTARY ROCKS	
STRATIGRAPHIC LEAKAGE	VERTICAL MIGRATION OF SELECTED MIOSPORES	

often selected on the basis of rock type. Cross (1964) suggested that different rock types should undergo different processes for disaggregation and digestion of the inorganic material, although he realized that these techniques have different effects on the entrapped miospores. Cross, Thompson and Zaitzeff (1966) stated that even subtle changes in preparation techniques may produce major differences in palynologic assemblages, and to minimize the bias which might have been introduced by faulty preparation, at least one-half of their samples were reprocessed.

Brookes and Thomas (1967) reported that the distribution of miospores on a microscope slide is not random. They suggested that clumping of grains arose either during sample preparation or by differential movement of grains when a cover slip was lowered on a liquid suspension of mounting media and miospores. The degree of clumping was greater toward the periphery of the cover slip than at the center on every slide examined by Brookes and Thomas, indicating that nonrandomness of miospores was a result of poor slide preparation technique.

When the mounting media was thinner at one end of the cover slip than at the other, or when the mounting media was very thin, differential movement of miospore types was noted by Brookes and Thomas. Large grains, apparently compressed between the cover slip and the slide, were prevented from moving, whereas smaller grains were free to move. Several suggestions have been offered to avoid the errors reported by Brookes and Thomas. Davis, Brewster and Sutherland (1969) obtained counts of 200 terrestrial miospore grains per slide by beginning at the center of a slide, making a series of transects in one direction until 100 terrestrial grains were counted, then returning to the center of

the slide and repeating the procedure, with the transects made in the opposite direction. Wilson (1959) and Schopf (1964) suggested that slides should be prepared by air-drying the palynological preparation mixed with a mountant (e. g., Clearcol, hydroxyethyl cellulose or polyvinyl alcohol) on the cover slip before cementing the cover slip to the slide. Thorough mixing of the preparation and mountant, and spreading the mixture uniformly over the cover slip, would lessen the degree of clumping and avoid a graded distribution of different size grains under the cover slip.

The sources of variation introduced during preparation and collection of palynological data are listed in Table IV, together with their controlling factors and the level of recognition for these sources.

It would be naive to think that the sources of variation discussed above are totally independent of one another, or that each source has had an effect on every assemblage. However, those sources of variation which affected the assemblages used in a study, but were not accounted for in the analysis performed on the data, would automatically inflate the estimate of inherent variation. Under such a situation, the efficiency of evaluating differences among the levels of the factors identified is reduced. If certain sources of variation are detected, and appropriate adjustments are made for these sources, more reliable biostratigraphic correlations can be made.

TABLE IV

SOURCES OF VARIATION INTRODUCED DURING THE COLLECTION AND TABULATION OF PALYNOLOGICAL DATA, THEIR CONTROLLING FACTORS AND THE LEVEL AT WHICH THEY CAN BE RECOGNIZED

<table>
<tr><th>SOURCE OF VARIATION</th><th>CONTROLLING FACTOR</th><th>LEVEL OF RECOGNITION</th></tr>
<tr><td>FROM SAMPLE TO SAMPLE PREPARED FROM THE SAME LITHOLOGIC UNIT</td><td>1) CHANCE
2) INCONSISTENT LABORATORY PROCEDURES</td><td rowspan="4">MOST EASILY RECOGNIZED WHEN THE APPROPRIATE STATISTICAL TESTS ARE PERFORMED</td></tr>
<tr><td>CHEMICAL MACERATION TECHNIQUES</td><td rowspan="3">INCONSISTENT LABORATORY PROCEDURES</td></tr>
<tr><td>FROM SLIDE TO SLIDE PREPARED FROM THE SAME SAMPLE</td></tr>
<tr><td>WITHIN THE SAME SLIDE</td></tr>
<tr><td>OPERATOR ERROR</td><td>1) EXPERIENCE OF THE INVESTIGATOR
2) TAXONOMIC INSTABILITY</td></tr>
</table>

II. PRE-SELMA UPPER CRETACEOUS STRATIGRAPHY OF ALABAMA

Stratigraphic nomenclature

According to Stephenson (1914), the first attempt to classify the entire Upper Cretaceous Series of the eastern Gulf Coastal Plain was made in 1860 by Hilgard, who recognized four major lithologic units. In decending order, these units were called the Ripley Group, the Rotten Limestone Group, the Tombigbee Sand Group and the Eutaw Group. The Eutaw Group was defined as all the strata between the underlying Carboniferous strata and the overlying Tombigbee Sand Group.

Smith and Johnson (1887) modified the classification of Hilgard by dividing the Eutaw Group into a lower unit, the Tuscaloosa Formation, and an upper unit, the Eutaw Formation. The Eutaw Formation contained the Tombigbee Sand as an upper member.

Stephenson (1914) formally proposed the placement of the Tombigbee Sand as the upper member of the Eutaw Formation, as Hilgard ran the contact between the two units oblique to the strike, which made the section given as typical of the Eutaw Group equivalent to the Tombigbee Sand.

This classification remained essentially unchanged until 1944, when a study of pre-Selma stratigraphy was begun by the U.S. Geological Survey as part of a war-time program of oil and gas investigations. These investigations are summarized by Eargle (1946, 1948), Monroe, Conant and Eargle (1946), and Applin and Applin (1947). As a result

of these studies, the Tuscaloosa Formation was raised to group status, containing, in decending order, the Gordo Formation, the Coker Formation, the Eoline Formation and the Cottondale Formation. Unconformities were recognized between the Eoline and Coker formations, and between the Coker and Gordo formations. Locally, the Eoline Formation was noted to rest unconformably on the Cottondale Formation. In addition to the regional unconformity immediately above the Gordo Formation, a second unconformity was recognized within the Eutaw Formation (as defined by Stephenson, 1914). The McShan Formation was proposed for strata between these unconformities, thereby restricting the Eutaw Formation.

Drennen (1953) noted that the Cottondale Formation could not be traced laterally more than twenty miles in the vicinity of Tuscaloosa, Alabama, and abandoned the name Cottondale Formation for the lowermost Tuscaloosa beds. Because of the difficulty in distinguishing the Eoline and Coker formation, Drennen reduced the Eoline Formation to member status, and modified the Tuscaloosa Group to include two formations; the lower, Coker Formations, consisting of a basal Eoline Member, and a higher, unnamed member; and the upper, Gordo Formation. A comparison of these classifications, together with their relation to European stages and the standard Texas section is presented in Figure 1.

Stratigraphic relationships and facies changes

The basal pre-Selma Upper Cretaceous strata of Alabama unconformably overlie rocks of Lower Cretaceous age in the southern part of the state. To the north, they overlap the Lower Cretaceous rocks and rest unconformably on Paleozoic sedimentary and metamorphic rocks.

The basal Eoline Member of the Coker Formation is typically a

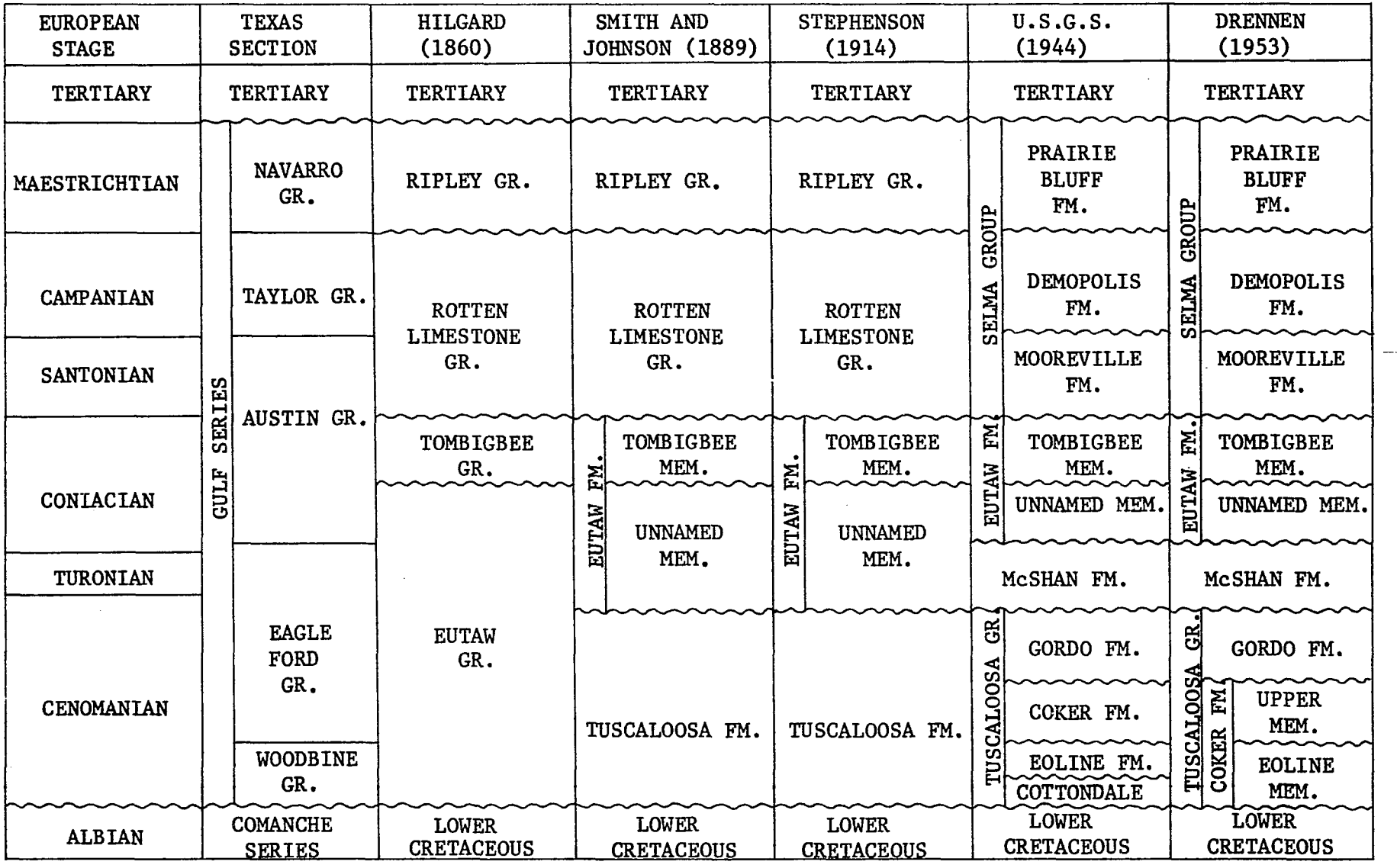

Figure 1. Comparison of the European stages and the standard Texas section with the various classifications of the Upper Cretaceous Alabama outcrop section.

stratified and cross-stratified, fine-grained sand, interbedded with carbonaceous and lignitic clay. The sediment is believed to be marine, as evidenced by the presence of fine-grained glauconite in many sand beds (Drennen, 1953). Correlation within the Eoline Member is difficult, as many of the beds are lenticular and can be observed pinching out in outcrop. Sohl (1964) indicated that the Eoline Member in western Alabama was deposited in a shallow, brackish, near-shore environment.

A possible bentonite layer marks the top of the Eoline Member (Monroe, 1955).

The upper, unnamed member of the Coker Formation is a light colored, micaceous sand, commonly containing mottled red and gray clay. Conant (1967) suggested that this upper member is nonmarine, for neither glauconite nor marine fossils have been observed. Spherules of siderite, limonite and hematite are abundant near the base of this member at the type locality in Tuscaloosa County, Alabama. Sorting is generally poorer in the basal portion (Bergenback, 1964).

A slightly undulating contact, marking a major unconformity, separates the Coker Formation from the overlying Gordo Formation.

At its type locality in western Alabama, the lower 130 feet of the Gordo Formation is predominantly a gravelly sand. This part of the Gordo Formation is the main gravel-bearing unit of the Tuscaloosa Group. Monroe, Conant and Eargle (1946) reported that these gravels consist chiefly of chert pebbles derived from Mississippian limestones of northern Alabama and Tennessee. Some quartz is present, possibly derived from the nearby Pottsville Formation of Pennsylvanian Age. The upper 170 feet of the Gordo Formation consists of lenticular beds of

red- or purple-mottled gray clay, carbonaceous clay and cross-bedded sand, which locally contains gravel. Siderite spherules are locally abundant.

Conant (1967) stated that the Coker and Gordo formations can be recognized as separate units as far east as Tuskegee, Alabama, but have not been differentiated beyond this point, whereas Drennen (1953) believes that the Coker Formation formed through continuous deposition in an expanding shallow sea, overlain and overlapped by the Gordo Formation, deposited in or very near a shallow sea.

Brett (1967) recognized a marked facies change within the Tuscaloosa Group. At its type locality in western Alabama, the sediments of the Tuscaloosa Group are highly indurated, cherty gravels containing glauconite, with their clays displaying a rather uniform color pattern. In eastern Alabama and Georgia, the Tuscaloosa Group contains less gravel and glauconite, is less indurated, the color pattern of the clays is more highly variable, and it is generally thinner than at its type locality. These differences are explained by Tanner (1955), whose study of cross-bedding dip directions led him to conclude that littoral currents were of greater importance in determining the nature of the sediments in eastern Alabama and Georgia, whereas stream flow dominated sediment distribution in western Alabama.

To the north, the Tuscaloosa Group becomes thinner and more gravelly than at its type locality, and, in the northeastern corner of Mississippi it is all chert gravel (Stephenson and Monroe, 1938).

An unconformity separates the Tuscaloosa Group from the McShan Formation.

At its type locality in Pickens County, Alabama, the McShan Formation consists of a basal pebbly sand, grading upward into a fine to medium glauconitic sand, overlain by fine to medium glauconitic silty sand, interbedded with gray sandy silt and clayey silt (Bergenback, 1964). Locally, well-rounded, flattened pebbles of concretionary earthy siderite and silicified and lignitized wood are common, as are Ophiomorpha burrows.

The McShan Formation is not recognized east of Montgomery County, Alabama, where it is overlapped by the Eutaw Formation. Pryor (1960) indicated that the Eutaw Formation also overlaps the McShan Formation to the north.

Although lithologically similar to the Eoline Member of the Coker Formation, the McShan Formation is believed to have been deposited in deeper water, as suggested by the more abundant glauconite. Applin and Applin (1947) recognized a deep-water marine facies of the McShan Formation in Mobile County, Alabama, where the sediment is more calcareous and silty than at its type locality. The contact between the McShan and the overlying Eutaw Formation is an unconformity.

The Eutaw Formation is typically a glauconitic marine sand, with fine gravel, lignite fragments, phosphate nodules, and sharks teeth common in its basal beds. Lithologically, it resembles the McShan Formation, but is generally coarser, and the glauconite is darker and more abundant than in the McShan Formation. Tabular and cross-stratification is common, usually with clay stringers along the cross-beds. The upper member of the Eutaw Formation is known as the Tombigbee Sand Member, and is a massive to weakly bedded light gray, somewhat clayey, highly glauconitic sand, with abundant burrows and many mollusk shells

(notably Exogyra ponderosa, Gryphaea wratheri and Ostrea battensis).

Between Montgomery and Russell Counties, Alabama, the lower unit of the Eutaw Formation is absent, and only the Tombigbee Sand Member and its equivalents are recognized. These units are traceable into Georgia. Facies changes within the Tombigbee Sand Member are abrupt in eastern Alabama and Georgia. In Russell County, Alabama, the Eutaw Formation is described as a coarse to very coarse, gravelly sand, grading upward into clay beds which are highly fossiliferous (Scott, 1964). In the Chattahochee River Valley, the Eutaw Formation consists of a basal massive marine sand, containing Ostrea cretacea, and an upper part of greenish-gray, somewhat laminated clay, with subordinate amounts of sand (Stephenson, 1956). Whereas the lower, basal sand in Georgia may be equivalent to the Tombigbee Sand of Alabama, Stephenson (1956) believes the upper shale may be younger than the Tombigbee Sand. To the east and north, the upper clay and fine sand grade into coarse sand (Eargle, 1955), and looses its marine characteristics. East of the Flint River in Georgia, the Eutaw Formation cannot be traced as a mappable unit, as it cannot be differentiated from the overlying Ripley Formation.

The Tombigbee Sand Member overlaps the lower part of the Eutaw Formation to the north, where it rests unconformably on sediments of the Tuscaloosa Group (Pryor, 1960).

Fossils from the Tombigbee Sand Member near its type locality in western Alabama represent a widespread oyster bank accumulation in shallow, brackish water (Sohl, 1964). Similar conclusions were reached by Scott (1964) for the Eutaw Formation in Russell County in eastern Alabama.

Although Conant (1967) described the McShan and Eutaw formations as generally deep water sediments on the basis of abundant glauconite, Bergenback (1964), and Knowles, Reade and Scott (1963), described the Eutaw Formation as typical of a shallow marine environment, fluctuating from quiet to well agitated waters, as indicated by randomly distributed silt and clay, and by sand which is generally coarser than that of the Coker Formation.

The Eutaw Formation is unconformably overlain by the Mooreville Chalk, the basal bed of which is commonly a calcareous sandstone having many reworked phosphatized internal molds of fossils from the underlying Tombigbee Sand Member (Conant, 1967).

The only evidence of structural deformation which occurred during pre-Selma Upper Cretaceous time is the faulted clays and shales of the Eutaw Formation in Georgia (Eargle, 1955). However, faulting during deposition of the Selma Group served to displace the Eutaw Formation as much as 950 vertical feet in western Alabama. This fault system is geographically in line with the Mexia Talco-South Arkansas-Pickens Gilbertown fault-trend, which fringes the Gulf Coast Salt Basin from Texas to Alabama, and serves as the major structural control for oil accumulation in sediments of the Eutaw Formation and the Selma Group. The faults trend east-west, and are normal gravity faults with an average dip of 45°.

A map showing the outcrop pattern of upper cretaceous rocks in Alabama with respect to the fault system is presented in Figure 2.

Age of the Tuscaloosa, McShan and Eutaw formations

The marine invertebrate fauna of the Tuscaloosa Group, the McShan Formation and the lower part of the Eutaw Formation is scarce, and

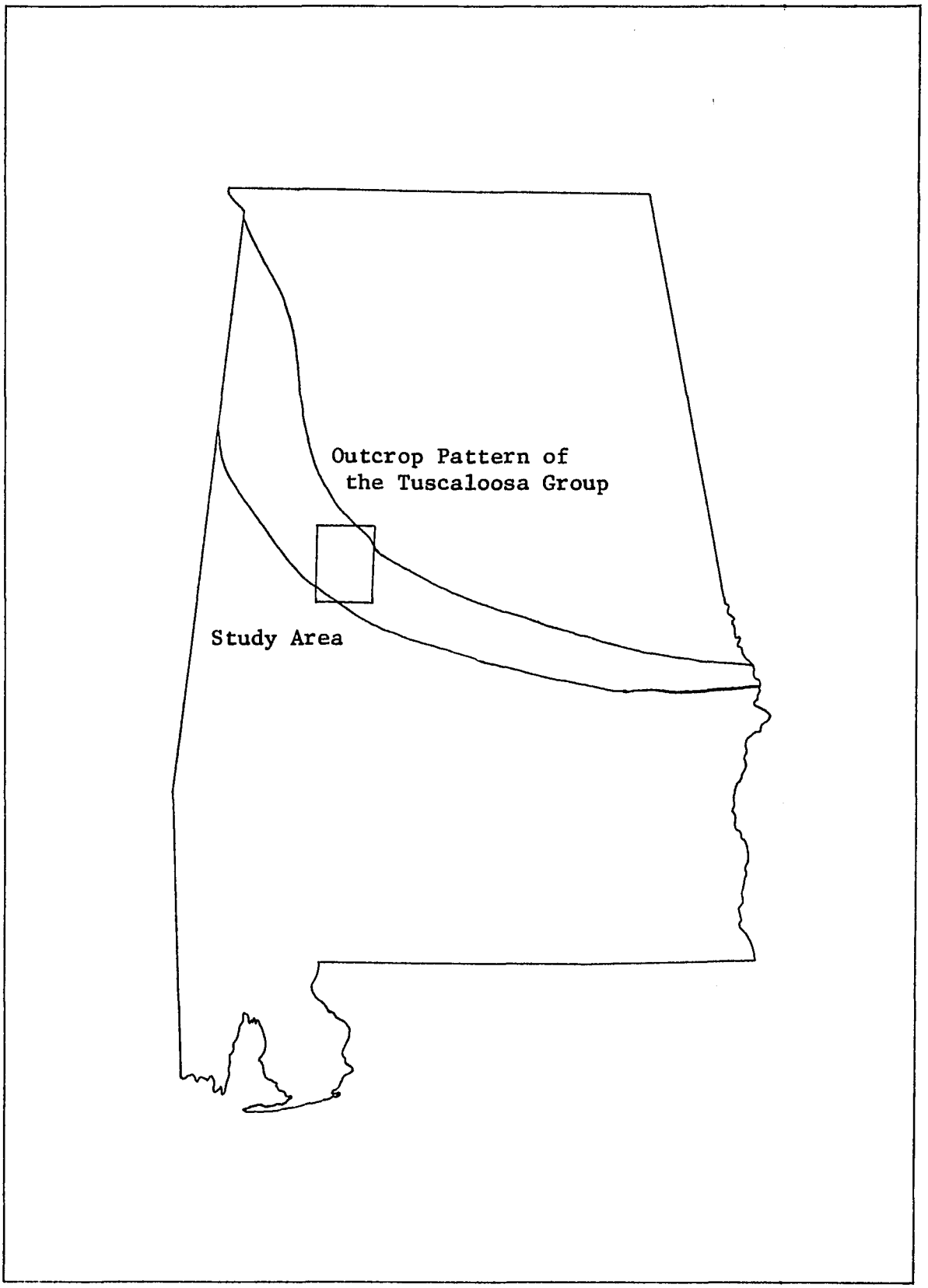

Figure 2. Map of Alabama showing the general outcrop pattern of the Tuscaloosa Group and the study area under consideration.

early dating of these units was based on Berry's (1919) study of plant remains.

According to Berry, the Tuscaloosa Group can be correlated with the Woodbine Group of Texas, the Raritan Formation of New Jersey, and the Cenomanian Stage of Europe. The lower part of the Eutaw Formation (including the McShan Formation) can be correlated with a large section of the Black Creek Formation of North Carolina and all of the Magothy Formation of New Jersey. With respect to European stages, Berry considered this unit to be pre-Senonian in age.

Sohl (1964) studied the larger invertebrates contained in core samples from western Alabama, and on the basis of the presence of Ostrea cf. O. soleniscus, he considered the Eoline Member of the Coker Formation to be of Cenomanian Age. Sohl noted the similarity between the Eoline Member of Alabama and the Woodbine Group of Texas. A study of the Foraminifera by Applin (1964) supported a Woodbine Group equivalency for the Eoline Member.

The fossils of the Gordo and McShan formations are non-diagnostic and do not allow for accurate correlation. For the most part, the fossils of the McShan Formation are crustaceans, with Hoploparia sp. aff. H. davisi relatively abundant (Sohl, 1964).

The Tombigbee Sand Member of the Eutaw Formation contains the most abundant invertebrate fauna of any of the pre-Selma Upper Cretaceous units in Alabama (see Stephenson and Monroe, 1938; Stephenson, 1956; Knowles, Reade and Scott, 1963; Sohl, 1964 for faunal lists). Young (1963) correlated the Dessau Limestone of Texas with the Tombigbee Sand Member of Mississippi on the basis of fossils common to both. On the basis of ammonites, Young considered the Dessau Limestone to be late

Santonian to earliest Campanian Age.

Young's correlation of the Tombigbee Sand Member with late Santonian to earliest Campanian Age agreed with that of Stephenson and Monroe (1938), which was based on the presence of a floating crinoid, Marsupites americanus. In Georgia, the Tombigbee Sand Member may be older than at its type locality. According to Stephenson (1956), the "Gryphaea wratheri zone" occurs in the upper 35 to 40 feet of the Tombigbee Sand Member in western Alabama, but in eastern Alabama and Georgia, this zone was recognized high enough in the overlying Mooreville Chalk to eliminate the possibility of reworking.

From the evidence cited above, it appears that the Tuscaloosa Group is of early and middle Cenomanian Age, the lower part of the Eutaw Formation is of early Coniacian Age, and the Tombigbee Sand Member is of late Coniacian and earliest Santonian Age.

Figure 3 is an east-west cross section of the upper cretaceous strata of Alabama, indicating the stratigraphic internal sampled for the present investigation.

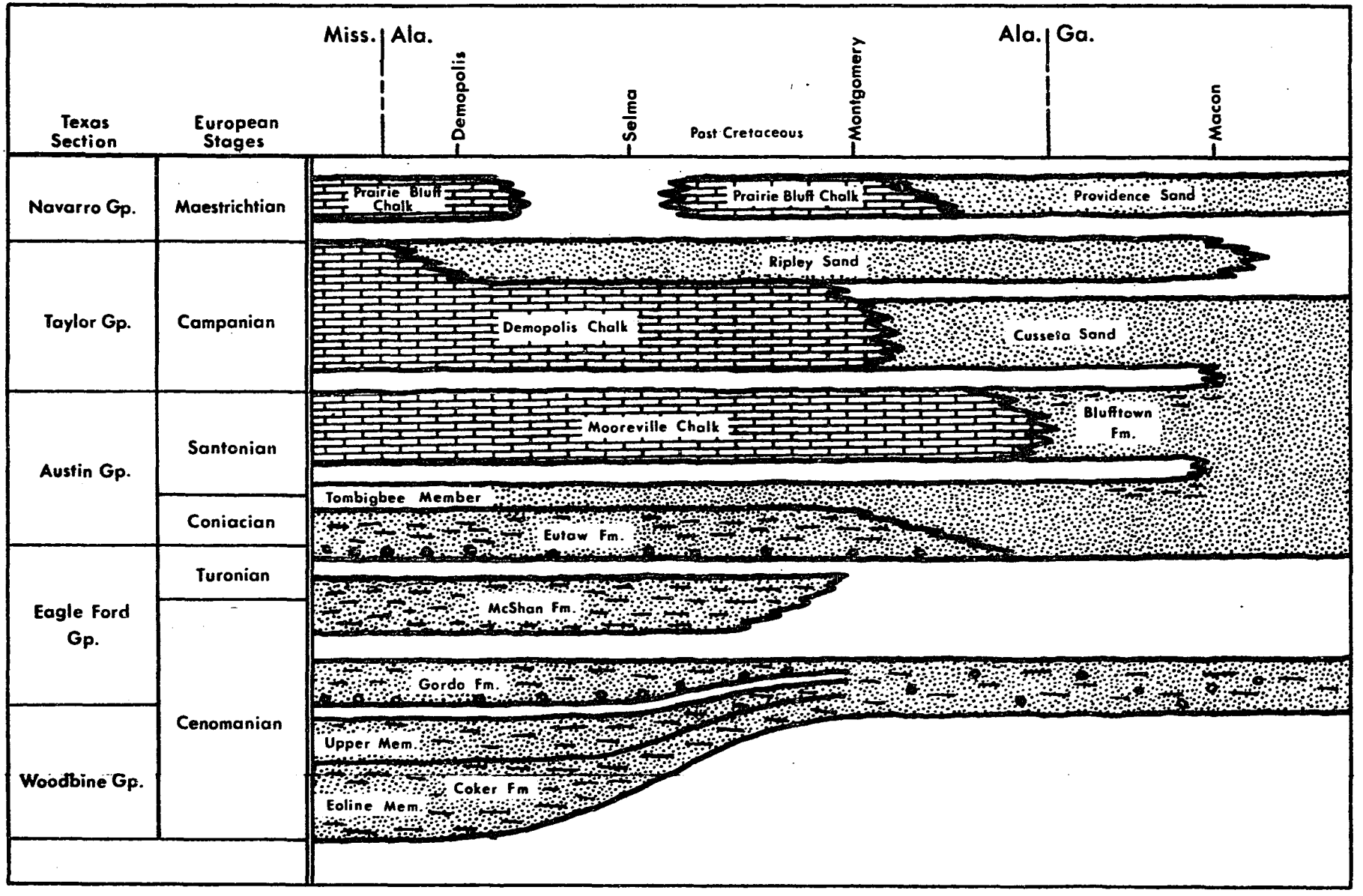

Figure 3. East-west cross section of the Upper Cretaceous strata of Alabama showing the relationship of the Tuscaloosa Group to the overlying beds.

III. MATERIALS AND METHODS

Samples for this investigation were obtained from quarter-cuts of two cores of the Coker Formation (Upper Cretaceous) in western Alabama. The location at which these cores were drilled is shown in Figure 4. The drilling of both cores began at the base of the Gordo Formation, penetrated the entire Coker Formation, and bottomed in Paleozoic sediments.

The cores were drilled in 1954 under the direction of the U.S. Geological Survey, in an attempt to obtain unweathered, undisturbed samples of pre-Selma Upper Cretaceous rocks near the type locality of the Coker, Gordo, McShan and Eutaw formations in western Alabama.

These cores, along with two others, were the subject of several publications. Monroe (1955) provided megascopic descriptions of the cores. Bergenback (1964) determined the distribution of grain sizes, determined the mineralogy of detrital grains and matrix, and made X-ray identification of the clay minerals. Applin (1964) studied the sparse microfauna, and described a new species of Foraminifera (Saccammina eolinensis Applin 1964) from the cores. Sohl (1964) compared the larger invertebrate fauna with assemblages collected from outcrops in Alabama and Texas. Leopold and Pakiser (1964) presented a preliminary report on the spore-pollen assemblages recovered from several carbonaceous clays contained in the cores. They illustrated only a portion of the forms recovered, and attempted a correlation of these samples with

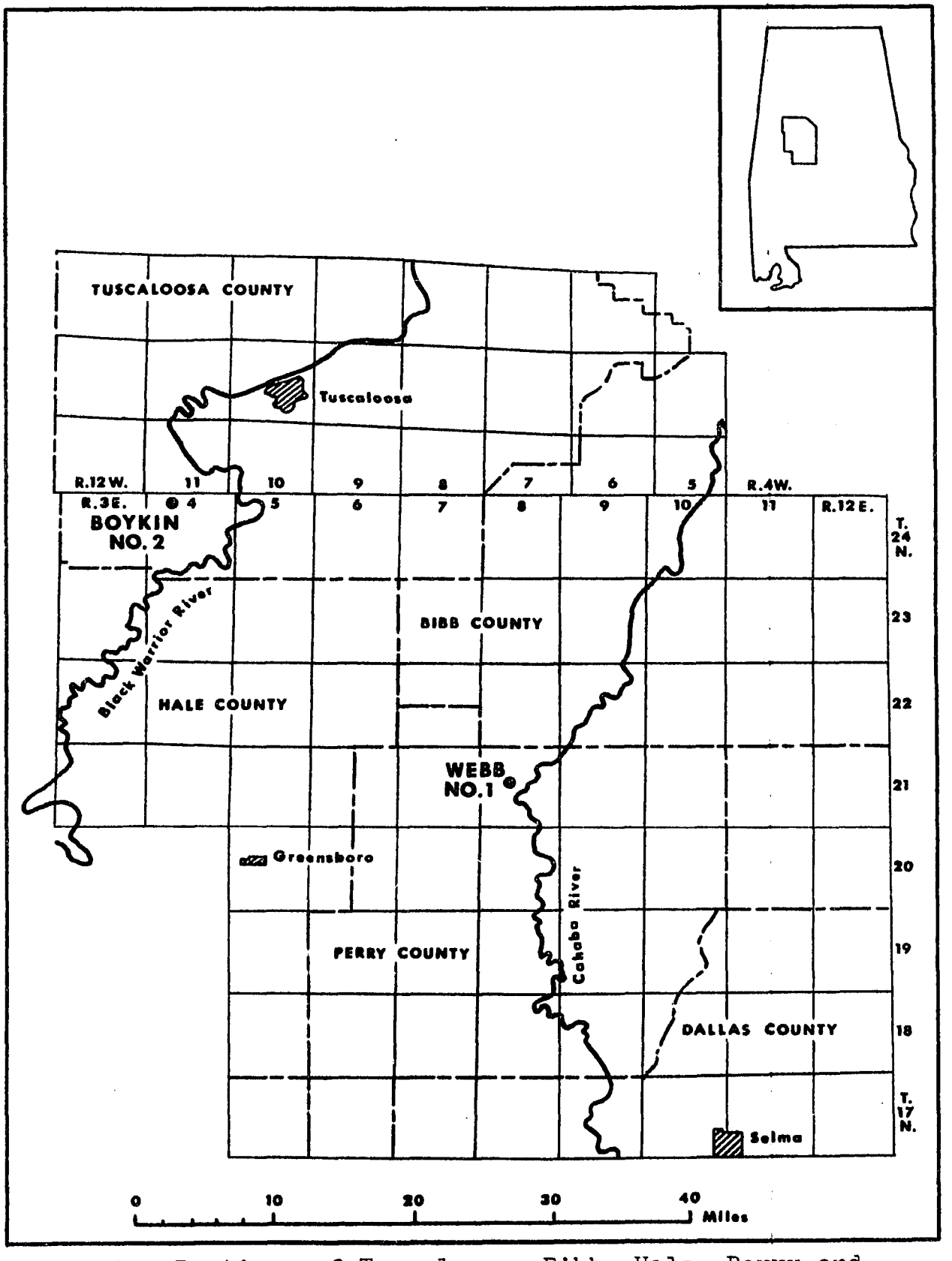

Figure 4. Portions of Tuscaloosa, Bibb, Hale, Perry and Dallas Counties, Alabama, showing the location of the Webb and Boykin core holes.

European stages.

Sampling procedure

Bergenback's (1964) report on the petrology of pre-Selma strata in western Alabama included grain-size analyses obtained from channel samples of both the Boykin and Webb cores. The median grain sizes and sorting coefficients ($\sqrt{Q_{25}/Q_{75}}$) presented by Bergenback are used in the present study, and his sampling intervals provided the basis for the selection of samples.

Bergenback's analyses were based on samples from fifty-two lithologic units in each core. In the quarter-cuts made available for this investigation, samples from all of the fifty-two units defined by Bergenback were represented in the Boykin core, but sample 14 (at a depth of 182.5'-185.5' below the surface), sample 43 (457.3'-460.0') and sample 44 (485.0'-487.3') were not represented in the Webb core. The individual lithologic units varied in thickness from six inches to fifteen feet. Two samples were taken from each lithologic unit to evaluate the variation displayed by each taxon within lithologic units. Although more accurate results regarding within-lithologic unit variation would have been obtained if channel samples had been taken and split into two homogeneous fractions, this procedure was not followed, as it would have destroyed the cores which were on loan from Shell Oil Company of New Orleans, Louisiana. Instead, fifty-to-one hundred gram samples were taken at one-third and two-thirds of the stratigraphic thickness of each lithologic unit, and the depth in the core for both samples was recorded as the depth of the midpoint of the lithologic unit sampled. Therefore, the two samples representing a lithologic unit had identical values for depth in the core, median grain size and

sorting coefficient.

Additional samples of lignites and carbonaceous clays were obtained from both cores, but the data provided by these units were not included in the analyses. Carbonaceous clays were sampled from a depth of 227.0'-230.0' below the surface in the Webb core, and in the Boykin core, from depths of 12.0'-14.0' and 348.0'-350.5'. One lignite was sampled in the Webb core, representing an interval 265.0'-267.0' below the surface. In the Boykin core, lignites were sampled from depths of 248.0'-250.0', 347.0'-348.0' and 352.0'-354.0' below the surface.

To avoid personal bias, numbers were randomly assigned to samples when they were collected, and each sample was identified by its number throughout the collection and analysis of the data.

Processing procedures

Palynomorphs were recovered from the samples by removing the inorganic matrix in a series of acid baths, followed by immergence in an oxidizing solution to remove unwanted organic matter. The steps employed in processing the samples are outlined in Table V.

Although initial sample size varied from 10 grams for carbonaceous clays and lignites to 50 grams for sands, and attempt was made to macerate all samples identically to minimize the variation introduced in the laboratory.

In those steps which require decantation, the supernate was filtered, and the residue remaining on the filter paper was washed back into the centrifuge tube. This avoided the loss of smaller particles that had remained in suspension during centrifugation and decantation.

All centrifugation was carried out at 3000 rpm for ten minutes.

A 1 per cent solution of potassium chlorate dissolved in a 45 per

TABLE V

PROCESSING PROCEDURES FOR PALYNOLOGICAL ANALYSIS

1. Wash sample with distilled water and place 10 to 50 grams in a properly washed and labelled beaker.
2. Add concentrated HCl to cover the sample by 1 inch. Allow the reaction to continue to completion.
3. Fill the beaker with distilled water. Allow the residue to settle (4 to 6 hours).
4. Decant, filtering supernate through a no. 541 filter paper.
5. Wash residue from the filter paper back into the beaker.
6. Repeat steps 3 to 5 three times.
7. After the last decanting, add 52% HF so that the sample is covered by 1 inch. Allow the reaction to continue to completion.
8. Repeat steps 3 to 5 four times.
9. After last decanting, add 1% Schulze Solution (1% KCO_3 dissolved in 45% HNO_3). Allow the reaction to continue 12 to 18 hours.
10. After the residue has settled, decant the supernate through a no. 541 filter paper.
11. Wash residue from the filter paper back into the beaker.
12. Transfer the residue from the beaker to a properly washed and labelled centrifuge tube.
13. Fill the centrifuge tube containing the residue with distilled water. Centrifuge, decant, and filter the supernate through a no. 541 filter paper.
14. Wash residue from the filter paper back into the centrifuge tube.
15. Repeat steps 13 to 14 twice more.
16. Add 3% KOH. Allow the reaction to continue 5 minutes.
17. Repeat steps 13 to 14 four times, or until supernate runs clear.
18. After last decantation, add three drops of diluted Safranin O. Allow 5 minutes for stain to penetrate miospore exine.
19. Repeat steps 13 to 14 twice more.
20. After last decantation, transfer residue to a properly washed and labelled storage vial.
21. Prepare slides.

cent nitric acid solution was used to oxidized the humic compounds. This step was followed by centrifuging the residue in 3 per cent potassium hydroxide, which successfully removed the unwanted organic matter.

Five slides were prepared for each sample. One drop of processed material and one drop of Clearcol Mounting Media were pipetted onto a No. 0 cover slip, mixed thoroughly, and allowed to dry in a warm oven for twenty minutes. The prepared cover slips were adhered to 3" x 1" glass slides with Caedax.

Collection of data

Of the five slides prepared for each sample, two were randomly selected and examined for palynomorph content. When no palynomorphs were present on either slide, the sample was assumed to be barren. In the Boykin core, all samples from lithologic units above 238.7' (represented by sample numbers 1 to 22) were barren. In the Webb core, lithologic units above 128.8', between 135.5' and 238.8', between 366.5' and 366.6', and below 515.6' were all barren. These intervals were represented by sample numbers 1 to 9, 11 to 21, 34, and 47 to 52.

For each productive slide, a total of one hundred and fifty palynomorph grains were counted. Included in this count were the frequency of occurrence of each identifiable species, as well as a sum of those grains which were not taxonomically identified because of poor preservation or orientation. These frequency counts are presented in Appendix B.

The probability of including at least one individual from every species which comprised two per cent or more of the population from a total count of 150 grains is 95 per cent. This probability statement assumes a random dispersion of palynomorphs on a slide, and is based on

the binomial distribution as outlined by Shaw (1964, pp. 107-110) and illustrated by Dennison and Hay (1967).

The species and genera of miospores identified were assigned to higher taxonomic categories which are based on similarities in morphological form. A taxonomic heirarchy developed to reflect phylogenetic relationships among fossil miospores is tenuous at best, especially during periods when certain groups were rapidly evolving, as with the angiosperms during the early Upper Cretaceous Period. In addition, miospore species differ as to the level in a natural heirarchy at which relationships among them can be established.

A system of higher taxonomic categories based on the presence or absence of morphological features has been used by numerous palynologists (Potonié, 1956, 1958, 1960; Dettmann, 1963). The system adopted in this study is basically the one proposed by Potonié (1956, 1958, 1960), which was amended by Hart (in manuscript) so that each level in the heirarchy is characterized by differences in the same morphological characteristic.

The fossil marine phytoplankton (dinophyceae cysts and acritarchs) recovered during this study were assigned to higher taxonomic categories according to the classification outline by Norris and Sarjeant (1965).

The vertical range of each species was established in each well, and all samples below the first appearance, or above the last occurrence of that species were eliminated from further consideration. Therefore, the data for each species consisted of the frequency of occurrence, out of a total count of 150 grains per slide, between the first and last occurrence of the species in each core. For each lithologic unit, four estimates of the frequency of occurrence of each taxon were obtained, as

two slides were examined from each of two samples taken from each lithologic unit.

Data for taxonomic categories above the species level were obtained by adding the frequencies of occurrence of species in that category on each slide.

Statistical techniques

Two statistical techniques were applied to the data collected during this investigation: a nested analysis of variance in a completely randomized design, and a backward elimination regression analysis, where the frequency of occurrence of a taxon was regressed on the median grain size, sorting coefficient and the linear, quadratic and cubic effects of the depth in the core from which a sample was taken.

Only those taxa whose vertical range encompassed five or more samples in at least one well were analyzed. For taxa whose vertical distribution encompassed fewer than five samples, no estimate of residual variation was available because estimation of the effects of the overall mean, the two grain size parameters, and depth, accounted for the total variation.

For both analyses, the experimental unit was the slide, and the frequency counts obtained for each taxon served as the observations made on these experimental units.

Nested analysis of variance. A nested analysis of variance was performed on the frequency of occurrence of each of 180 palynomorph taxa recovered in the course of the investigation. The linear additive model which expresses the performance of an individual observation is:

$$Y_{ijkl} = \mu + C_i + L_{ij} + S_{ijk} + \varepsilon_{ijkl}$$

where,

Y_{ijkl} = the frequency of occurrence of a taxon from the lth slide made from the kth sample of the jth lithologic unit, taken from the ith core,

μ = the overall mean,

C_i = the effect of the ith core as a deviation from the overall mean (i = 1, 2), NID (0, σ_c^2),

L_{ij} = the effect of the jth lithologic unit from the ith core as a deviation from the mean of all lithologic units from the ith core (j = 1, 2, ..., n, where n is the number of lithologic units sampled between the first appearance and last occurrence of a given taxon in the ith core), NID (0, σ_l^2),

S_{ijk} = the effect of the kth sample of the jth lithologic unit from the ith core as a deviation from the mean of all samples taken from the jth lithologic unit in the ith core (k = 1, 2), NID (0, σ_s^2),

ε_{ijkl} = the effect of the lth slide made from the kth sample of the jth lithologic unit in the ith core as a deviation from the mean of all slides made from the kth sample of the lth lithologic unit in the ith core (l = 1, 2), NID (0, σ_e^2).

These analyses are presented in Appendix C, with the analysis for each taxon including the degrees of freedom, mean square, and variance component associated with each source of variation. The calculations involved in obtaining the appropriate degrees of freedom and mean square can be found in Sokal and Rohlf (1969, pp. 256-265).

Variance components were obtained by equating the appropriate mean square with its expectation, and solving for that variance component. The expectations of the mean squares for the sources of variation recognized in the nested analysis of variance are:

Cores	$\sigma^2_e + 2\sigma^2_s + 4\sigma^2_l + k\sigma^2_c$
Lithologic units/Cores	$\sigma^2_e + 2\sigma^2_s + 4\sigma^2_l$
Samples/Lithologic units/ Cores	$\sigma^2_e + 2\sigma^2_s$
Slides/Samples/Lithologic units/Cores	σ^2_e

The coefficient for each variance component represents the number of slides used to obtain means at each level in the hierarchy. Two slides were examined for each sample, and two samples were prepared from each lithologic unit, resulting in four slides to estimate the mean frequency of occurrence of a taxon in every lithologic unit. The number of lithologic units varied from core to core, thus the number of slides per core is represented by a coefficient which is weighted according to the number of slides per core. This coefficient was obtained from the formula:

$$k = n... - \frac{\sum n_{i..}^2}{n...}$$

(Note: degrees of freedom was 1 in the analysis of variance), where,

$n...$ = the total number of slides examined in a given analysis,

$n_{i..}$ = the number of slides examined from the ith core used in that analysis.

For each taxon, a comparison was made between the variance components for slides-within-samples, and samples-within-lithologic units, as the size of these variance components reflects the relative amount of variation introduced during slide and sample preparation respectively. Where applicable, implications of this comparison on individual taxa are discussed in Appendix A, and generalized conclusions concerning these variance components are discussed in Chapter IV.

The implications of statistically significant differences from core to core and from lithologic unit to lithologic unit within cores are discussed in the following chapter, but the inclusion of these variance components in the comparison mentioned above is meaningless, as these sources of variation are not directly related to variation introduced in the laboratory.

Regression analysis. The data for each taxon in each core was analyzed according to a backward elimination regression technique, in order to measure and evaluate the influence of changes in median grain size, sorting coefficient, and the linear, quadratic and cubic effects of depth on the frequency of occurrence of that taxon.

The median grain size and sorting coefficient for each sample were obtained from the data published by Bergenback (1964). The depth of each sample was recorded as the distance (in feet) below the surface of the midpoint of the lithologic unit sampled. For the lithologic units occurring between the first and last palynomorph-yielding sample in the Webb core, the distance from the surface to the top and bottom of each lithologic unit, its mean depth, median grain size and sorting coeffi-

cient are presented in Table VI, and in Table VII for the lithologic units from the Boykin core.

As biostratigraphy is based on evolution through time, and depth was used to represent relative time (through the Law of Superposition), the quadratic and cubic effects of depth, as well as the linear effect, were included in the regression model to characterize the influence of depth (time) more precisely.

The linear additive model initially applied to the data is:

$$Y_{ij} = \alpha + \beta_1 d_i + \beta_2 d_i^2 + \beta_3 d_i^3 + \beta_4 m_i + \beta_5 s_i + \varepsilon_{ij}$$

where,

Y_{ij} = the frequency of occurrence of a taxon on the jth slide of the ith sample,

α = the Y-intercept (the value of the dependent variable when depth, median grain size and sorting coefficient are all equal to 0),

β_1 = the partial regression coefficient of frequency of occurrence on the linear response of depth (d),

β_2 = the partial regression coefficient of frequency of occurrence on the quadratic response of depth (d^2),

β_3 = the partial regression coefficient of frequency of occurrence on the cubic response of depth (d^3),

β_4 = the partial regression coefficient of frequency of occurrence of median grain size (m),

β_5 = the partial regression coefficient of frequency of occurrence on sorting coefficient (s),

d_i = the depth of the ith sample,

m_i = the median grain size of the ith sample,

s_i = the sorting coefficient of the ith sample,

ε_{ij} = random error, NID (0, σ_e^2).

Tests of significance were performed on each of the five partial regression coefficients included in the initial model. When one or more was determined nonsignificant at the .05 level of probability, the term contributing the least to the explanation of changes in frequency of occurrence was deleted from the analysis and the change in frequency of occurrence to a unit change in each of the four remaining independent variables was determined. This deletion process was repeated until the resulting prediction equation contained only those terms which significantly effected the change in the frequency of occurrence of that palynomorph taxon. The calculations required to obtain and evaluate these partial regression coefficients are explained in Snedecor and Cochran (1967, Chapter 13).

Using the procedure described above, two prediction equations were generated for each taxon: one for each core included in the study. Only those miospore species whose frequency of occurrence was controlled by changes in depth, independent of changes in median grain size and sorting coefficient in both cores, were used to establish biostratigraphic florizones. These florizones were based on the concurrent ranges of these miospore species.

TABLE VI

INDEPENDENT VARIABLES USED IN REGRESSION ANALYSES FOR WEBB CORE HOLE

SAMPLE NUMBER	DEPTH MEAN	DEPTH RANGE	MEDIAN GRAIN SIZE	SORTING COEFFICIENT
10	132.1	128.8-135.5	0.045	9.9
11	137.8	135.5-140.0	0.037	5.0
12	150.6	145.0-156.2	0.210	1.4
13	161.9	156.2-167.6	0.280	1.4
15	191.6	190.1-193.1	0.036	6.9
16	202.6	201.3-204.0	0.006	5.1
17	207.7	206.4-209.0	0.064	4.6
18	221.9	220.2-223.5	0.001	4.9
19	225.1	223.5-226.8	0.073	3.3
20	231.2	229.8-232.6	0.013	3.8
21	235.4	232.6-238.2	0.170	1.2
22	243.4	238.8-248.0	0.042	9.4
23	254.5	248.0-261.0	0.060	2.4
24	263.0	261.0-265.0	0.100	1.5
25	272.1	267.0-277.2	0.120	1.9
26	279.6	277.2-282.0	0.165	1.4
27	284.0	282.0-286.0	0.075	5.1
28	294.4	292.7-296.1	0.067	3.9
29	306.3	299.6-311.0	0.063	4.7
30	333.0	330.0-336.0	0.077	1.3
31	337.4	336.0-338.8	0.203	1.3
32	352.0	350.0-354.0	0.115	1.5
33	365.0	364.0-366.0	0.078	1.6
34	366.5	366.5-366.6	0.245	1.3
35	368.2	366.8-369.8	0.063	5.7
36	371.3	369.8-372.8	0.145	1.4
37	375.0	374.3-375.8	0.155	1.7
38	424.5	422.0-427.0	0.190	1.3
39	437.5	435.5-439.5	0.098	2.6
40	443.9	442.3-445.5	0.041	3.0
41	453.8	452.7-454.8	0.174	1.4
42	455.6	455.0-456.2	0.180	1.2
45	507.5	506.0-509.0	0.075	3.2
46	512.2	509.0-515.5	0.257	1.3

TABLE VII

INDEPENDENT VARIABLES USED IN REGRESSION ANALYSES FOR BOYKIN CORE HOLE

SAMPLE NUMBER	DEPTH MEAN	DEPTH RANGE	MEDIAN GRAIN SIZE	SORTING COEFFICIENT
23	239.3	235.8-242.7	0.045	2.3
24	245.7	245.4-246.0	0.044	3.0
25	246.2	246.0-246.4	0.056	9.9
26	254.2	249.2-259.2	0.032	8.6
27	261.6	259.2-264.0	0.047	9.3
28	273.7	271.4-276.0	0.131	1.4
29	284.0	281.0-286.6	0.073	9.9
30	287.8	286.6-289.0	0.073	9.9
31	291.2	290.0-292.5	0.064	7.7
32	297.2	292.5-302.0	0.105	1.7
33	308.7	307.0-310.5	0.165	1.2
34	312.3	310.5-314.2	0.041	9.2
35	317.1	314.2-320.0	0.060	7.3
36	325.5	320.0-331.0	0.085	5.5
37	344.1	343.1-345.1	0.079	2.4
38	346.8	345.1-348.5	0.060	5.2
39	366.9	366.0-367.7	0.031	8.3
40	368.4	367.7-369.0	0.042	7.2
41	373.6	369.0-378.1	0.036	9.4
42	381.6	378.1-385.1	0.001	2.8
43	387.4	386.8-388.1	0.056	2.6
44	391.0	390.0-392.0	0.165	1.2
45	395.6	393.3-398.0	0.068	1.9
46	436.1	435.5-436.7	0.029	8.6
47	441.3	436.7-444.0	0.051	9.7
48	446.5	445.3-447.6	0.061	4.8
49	458.0	457.0-459.0	0.155	1.2
50	462.8	459.4-466.2	0.068	2.1
51	478.5	477.0-480.0	0.100	1.3
52	505.0	500.0-510.0	0.300	1.3

IV. RESULTS AND CONCLUSIONS

One hundred and seventy-seven palynomorph species were recovered during this investigation. Seventeen were classified as marine phytoplankton, five as reworked Paleozoic miospores, and the remaining one hundred and fifty-eight as miospore species produced by plants which lived contemporaneously with deposition of the sediments sampled. Taxonomic and biostratigraphic remarks concerning all of the taxa are presented in Appendix A.

In all, one hundred and eighty species, genera and higher taxa were analyzed, using the techniques described in Chapter III. The conclusions presented in this chapter are based only on the results of the analyses performed on the miospore taxa, as it is not known if the analyses performed on taxa of marine phytoplankton are biostratigraphically reliable. Miospores are capable of incorporation and preservation in sediment deposited in either terrestrial or marine environments, but marine phytoplankton can be incorporated only in marine deposits. Therefore, it is doubtful if the techniques applied to miospore taxa for correlating rocks representing both marine and terrestrial environments can be successfully employed on taxa of marine phytoplankton.

Variance components obtained from the nested analyses of variance allowed conclusions to be drawn concerning the introduction of variation into palynological investigations during the laboratory prepara-

tion of samples. On the basis of the prediction equations derived from the regression analysis applied to the same data, conclusions are drawn which concern:

1) the effect of changes in grain size parameters on the distribution of selected miospore species;
2) the establishment and stratigraphic correlation of florizones;
3) the geographic variation in the distribution of miospore taxa.

Implications concerning the provinance of the Coker Formation of western Alabama are made based on the presence of five reworked Paleozoic miospores.

The introduction of variation during laboratory preparation of palynological samples

Appendix C contains the results of a nested analysis of variance performed on each species, genus and higher taxonomic category. Each analysis of variance table includes the degrees of freedom, mean square and variance component associated with each recognized source of variation. With the exception of the fifteen species listed in Table VIII, recorded from samples of only one core, these sources of variation are:

1) the variation from core to core;
2) the variation from lithologic unit to lithologic unit within the same core;
3) the variation from sample to sample taken from the same lithologic unit;
4) the variation from slide to slide prepared from the same sample.

Variation displayed from core to core reflects inconsistent areal dispersal of miospore taxa, and is not related to variation introduced

TABLE VIII

MIOSPORE SPECIES OBSERVED FROM ONLY ONE CORE

SPECIES	CORE
Unidentified Apiculate Sporomorph 1	Webb
Lygodioisporites cf. *L. perverrucatus*	Webb
Chomotriletes fragilis	Boykin
Microreticulatisporites pseudofoveolatus	Boykin
Retitriletes pluricellulus	Boykin
Unidentified Muronate Sporomorph 1	Webb
Unidentified Muronate Sporomorph 2	Webb
Rouseisporites sp.	Webb
Unidentified Zonate Sporomorph 1	Webb
Unidentified Cingulate Sporomorph 2	Boykin
Trilobosporites sp.	Boykin
Camarozonosporites insignis	Webb
Unidentified Saccate Sporomorph 1	Boykin
Eucommiidites sp.	Webb
Unidentified Tricolporate Sporomorph 2	Webb

in the laboratory. Variation displayed from one lithologic unit to another in the same core reflects changes in frequency of occurrence which are directly related to either changes in lithology or changes in time. This source of variation does not result from inconsistent laboratory procedure.

In addition to any inherent variability, the variation displayed from one sample to another taken from the same lithologic unit includes the variation introduced as a result of inconsistencies in the techniques used to extract and detect miospores. Therefore, the variance component for samples-within-lithologic units reflects, in part, the chemical treatment that sample underwent.

Variation displayed from slide to slide made from the same sample is essentially a reflection of one's ability to prepare uniform slides.

A comparison of the variance components for samples-within-lithologic units and slides-within-samples indicates if greater variation was introduced during slide preparation or during sampling and chemical maceration of samples. In the analyses for all but fourteen taxa (listed in Table IX), the variance component for slides-within-samples was larger than the variance component for samples-within-lithologic units. Thus, it was concluded that, in general, greater variation was introduced during slide preparation than was introduced during the chemical and physical preparation of samples.

The fourteen taxa in which the variance component for samples-within-lithologic units was larger than the variance component for slides-within-samples includes species, genera, infraturma and subturma of both the Pollenites and Sporites. There are no apparent morphologic characteristics common to all of these taxa, and a greater understanding

TABLE IX

MIOSPORE TAXA WHOSE VARIANCE COMPONENT FOR SAMPLES-WITHIN-LITHOLOGIC UNITS IS GREATER THAN THAT FOR SLIDES-WITHIN-SAMPLES

Genus *Todisporites*

Todisporites scabratus

Subturma Zonotriletes

Infraturma Zonati

Infraturma Velati

Peromonolites allenensis

Classopollis torosus

Tricolpopollenites minutus

Infraturma Ptychotriporiti

Genus *Tricolporopollenites*

Unidentified Tricolporate Sporomorph 2

Genus *Complexiopollis*

Complexiopollis praetumescens

Schizosporis majusculus

of the reaction of these miospores to transporting and depositional processes is necessary before any explanation can be advanced to explain their response.

Darrell and Hart's (1970) investigation of the use of absolute miospore frequency in distinguishing environments of the modern Mississippi River Delta, showed that greater variation was displayed among samples taken at each location within the deltaic environments than among slides prepared from the same sample. Inasmuch as the variable they measured was the total number of miospores per gram of sediment, and not the relative abundance of individual taxa, the results presented here, and those presented by Darrell and Hart are not directly comparable. However, it appears that palynological investigations which employ absolute miospore determinations should concentrate on selecting and preparing representative and homogeneous samples, whereas investigations employing relative abundance should concentrate on preparing uniform slides.

Conclusions based on the prediction equations of miospore taxa

The prediction equations for the taxa analyzed in the Webb and Boykin cores are presented in Appendix D, together with the proportion of the total variation displayed by the frequency of occurrence of each taxon that is accounted for by each equation. The initial regression model applied to the data for each taxon in each core contained estimates of two grain size parameters, as well as relative time, indicated by the linear, quadratic and cubic effects of depth. Therefore, the resulting prediction equations provided the basis for a discussion of the effect of changes in lithology on miospore taxa, and to palynofloral correlations. Comparisons of prediction equations obtained for individ-

ual taxa in each core suggested differences in the geographic distribution of miospores.

Discussion of miospore variation related to changes in grain size distribution. The grain size distribution of each lithologic unit was characterized by its median grain size and sorting coefficient, as determined by Bergenback (1964). For a given taxon, the effects of these variables on frequency of occurrence were always combined with depth in one or both cores. Thus, the relative abundance of lithologically controlled miospore species from a sample of an unknown depth cannot be predicted from the median grain size and/or sorting coefficient. However, the partial regression coefficients obtained for median grain size and sorting coefficient do estimate the change in frequency of occurrence with a unit change in that grain size parameter, holding the effect of depth constant. Therefore, the effect of changes in median grain size and/or sorting coefficient on frequency of occurrence of miospore species can be characterized. This characterization was accomplished by examining the sign of the partial regression coefficient for all miospore species whose frequency of occurrence was related to changes in either or both grain size parameters. The probability that a species would display an increase in relative abundance with a unit increase in one or the other of the grain size parameters was compared to the probability that a species would display a decrease in relative abundance with a unit increase in that same parameter, with the binomial test (see Siegel, 1956, pp. 36-42). In the analysis of both sorting coefficient and median grain size, only miospore species controlled by one or both parameters in a single core, or which displayed the same sign in both cores, were included. Higher taxonomic categories were

not included in these analyses, as their prediction equations could not be considered independent of the prediction equations for species. These tests of hypotheses are presented in Appendix E.

The binomial test performed on species which varied with changes in sorting coefficient indicated that a unit increase in sorting coefficient increased the frequency of occurrence of these miospore species. Apparently, poorly sorted sediments contain a higher proportion of individuals of taxa related to changes in sorting, than do well sorted sediments. Sediments can be sorted either by the selective exclusion of certain grain sizes from deposition, or by the winnowing of fine particles after deposition. Because it cannot be ascertained which of these methods produced the sorting displayed by the lithologic units sampled, it cannot be determined if the relationship between sorting and relative abundance is dependent upon one or more of the processes involved in the sorting of sediment, or merely reflects the degree of sorting, independent of the factors involved in producing sorted sediment.

The binomial test applied to species which displayed a frequency of occurrence partially or wholly controlled by changes in median grain size indicated that the probability of a species increasing in frequency of occurrence wih a 1 mm increase in median grain size is the same as the probability that a species will decrease in frequency of occurrence with a 1 mm increase in median grain size. The effect of changes in median grain size on frequency of occurrence was further characterized, and an attempt was made to determine if there was a difference in the median grain size of sediment containing species with a positive and those with a negative partial regression coefficient of frequency of

occurrence on median grain size. For each species, the samples between its first and last occurrence were ranked according to median grain size. The median of this set of ranked data was used to characterize the median grain size of samples in which that species was observed. These median grain sizes were again ranked, from smallest to largest, and assigned values such that a value of 1 was assigned to the smallest, 2 to the next smallest, etc. (see Siegel, 1956, p. 124 for the calculation of values for tied observations). The species and their ranked values were dichotomized into those with a negative and those with a positive partial regression coefficient. The Mann-Whitney U Test was applied to these ranks, and the results are presented in Table X. As the U test statistic was larger than the tabulated U value for a two-tailed test and a 0.05 significance level, it was concluded that those species whose frequency of occurrence decreased with a 1 mm increase in median grain size were observed in samples with a larger median grain size than those which increased with a 1 mm increase in median grain size. This suggested that there is an optimum median grain size, or range of grain sizes, for use in palynological investigations. The frequency of occurrence of miospore species recovered from these samples would be uninfluenced by median grain size, thus eliminating the consideration of this lithologic parameter in explaining observed variation.

A further result of the analyses performed on miospore species whose frequency of occurrence varied significantly with changes in sorting coefficient and/or median grain size, was that the morphology of miospores apparently did not influence their association with the lithologic parameters.

TABLE X

DATA USED IN MANN-WHITNEY U TEST FOR EVALUATING DIFFERENCES IN MEDIAN GRAIN SIZE BETWEEN MIOSPORE SPECIES WITH A POSITIVE AND A NEGATIVE PARTIAL REGRESSION COEFFICIENT OF FREQUENCY OF OCCURRENCE OF MEDIAN GRAIN SIZE

NEGATIVE PARTIAL REGRESSION COEFFICIENT

SPECIES	MEDIAN GRAIN SIZE	RANK
Cedripites cretaceus	.100	26
Rugubivesiculites woodbinensis	.100	26
Calamospora mesozoica	.076	24
Cyathidites australis	.071	21.5
Tricolporopollenites cf. T. aliquantulus	.071	21.5
Tricolporopollenites sp. 1	.071	21.5
Cicatricosisporites dorogensis	.062	16
Tricolporopollenites sp. 2	.062	16
Cicatricosisporites venustus	.060	8
Tricolpopollenites retiformis	.060	8
Tricolpopollenites parvulus	.060	8
Tricolporopollenites sp. 1	.060	8

$R_1 = 204.5$

$n_1 = 12$

POSITIVE PARTIAL REGRESSION COEFFICIENT

SPECIES	MEDIAN GRAIN SIZE	RANK
Monolites intragranulosus	.130	30
Cirratriradites teter	.115	29
Acanthotriletes sp. 2	.107	28
Schizosporis parvus	.100	26
Cycadopites nitidus	.071	21.5
Unidentified Palynomorph 2	.070	19
Cingulatisporites levispeciosus	.065	18
Verrucatosporites pseudoreticulatus	.062	16
Rugubivesiculites woodbinensis	.061	13.5
Classopollis torosus	.061	13.5
Cedripites cretaceus	.060	8
Abietineaepollenites microalatus	.060	8
Abietineaepollenites microreticulatus	.060	8
Tricolpopollenites parmularius	.060	8
Retitricolpites cf. R. georgensis	.060	8
Unidentified Tricolporate Sporomorph 1	.058	3
Leiotriletes paramaximus	.056	1.5
Acanthotriletes sp. 1	.056	1.5

$R_2 = 260.5$

$n_2 = 18$

Biostratigraphic correlation and the establishment of florizones. Thirty-two miospore taxa exhibited prediction equations in which frequency of occurrence was controlled by changes in depth, but was independent of changes in median grain size and sorting coefficient. These taxa, listed in Table XI, served as the basis for biostratigraphic correlation of the Webb and Boykin cores, and in characterizing the florizones recognized.

Biostratigraphic correlation was accomplished by examining the concurrent ranges of the twenty-one miospore species listed in Table XI. The distribution of these species in the Webb core is illustrated in Figure 5, and in Figure 6 for the Boykin core. Inasmuch as depth was the only control exerted on their frequency of occurrence, the first appearance and last occurrence of these species in a vertical sequence of rocks was interpreted as corresponding to an event which was not related to changes in lithology. Therefore, the correlation presented here is not influenced by the ranges of lithologically controlled species.

A visual appraisal of the ranges of these species in both the Webb and Boykin cores indicated that three florizones can be recognized in each core. These florizones are referred to as Florizone A, Florizone B and Florizone C. The stratigraphic position and thickness of these florizones in each core is indicated on Figures 5 and 6.

Florizone A, stratigraphically the lowest of the three florizones, lies below 466 feet (as measured from the surface) in the Boykin core, and below 375 feet in the Webb core. The lower limit of this florizone could not be established, as no palynomorphs were recovered from samples below 515 feet in the Webb core, and the florizone extended through the

TABLE XI

MIOSPORE TAXA WHOSE FREQUENCY OF OCCURRENCE VARIED WITH CHANGES IN DEPTH, INDEPENDENT OF CHANGES IN GRAIN SIZE PARAMETERS

SPECIES:

- *Todisporites scabratus*
- Unidentified Apiculate Sporomorph 2
- *Klukisporites pseudoreticulatus*
- *Costatoperforosporites* spp.
- *Cicatricosisporites carlylensis*
- *Laevigatosporites ovatus*
- *Inaperturopollenites dubius*
- *Taxodiaceaepollenites hiatus*
- *Perinopollenites elatoides*
- *Rugubivesiculites rugosus*
- *Cedripites canadensis*
- *Alisporites bilateralis*
- *Ephedripites* sp.
- *Liliacidites dividuus*
- *Palmaepollenites tranquillus*
- *Palmaepollenites* ?
- *Tricolpopollenites minutus*
- *Sporopollis pseudosporites*
- *Sporopollis* sp. 1
- *Conclavipollis densilatus*
- *Quercoidites* ?

GENERA:

- *Acanthotriletes*
- *Laevigatosporites*
- *Sporopollis*

INFRATURMA:

- Apiculati
- Laevigatomonoleti
- Tricrassati
- Psilonapiti
- Triporiti

SUBUTRMA:

- Monoletes
- Zonotriletes

TURMA:

- Aletes

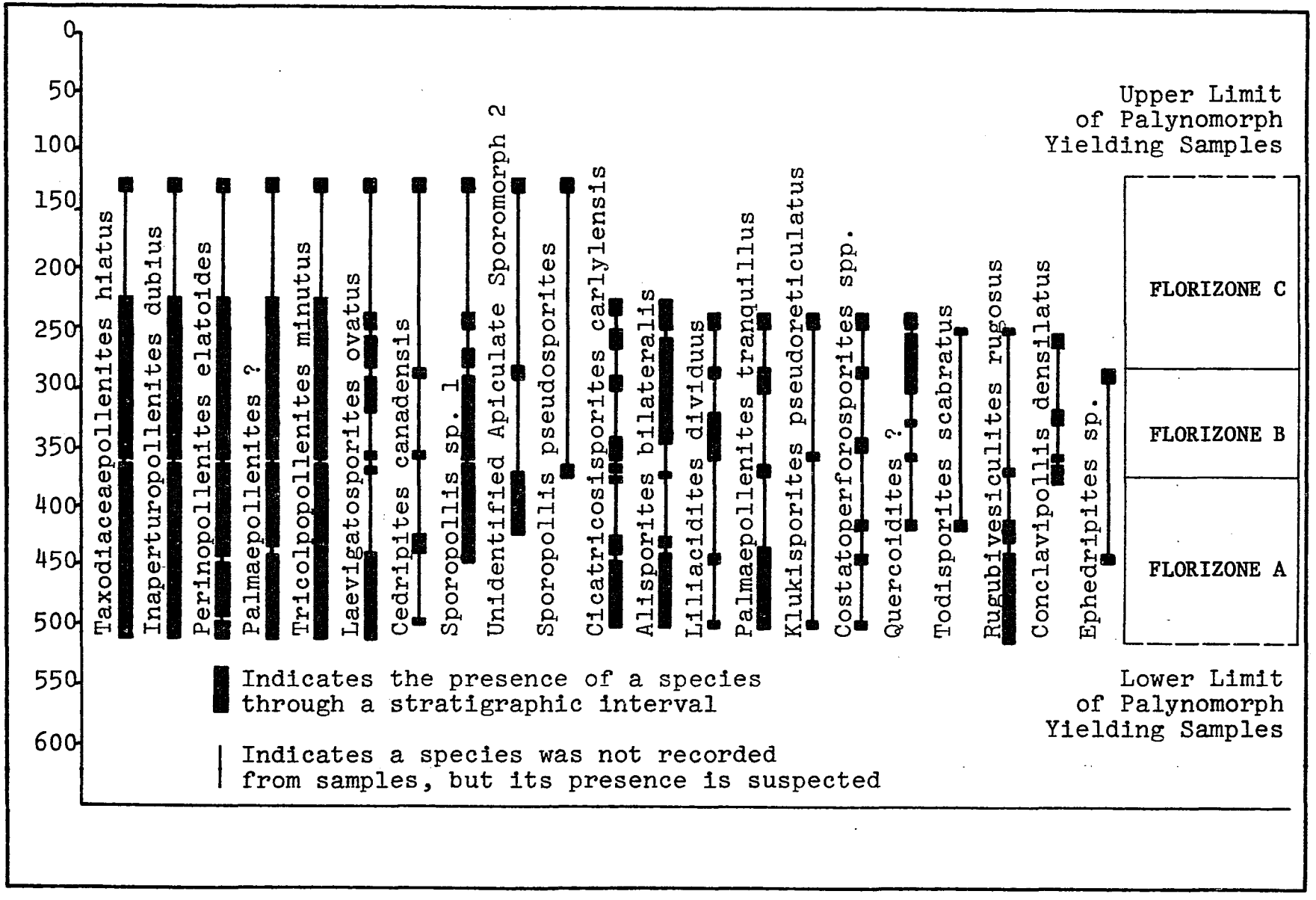

Figure 5. Vertical distribution of biostratigraphically important miospore species in the Webb core hole.

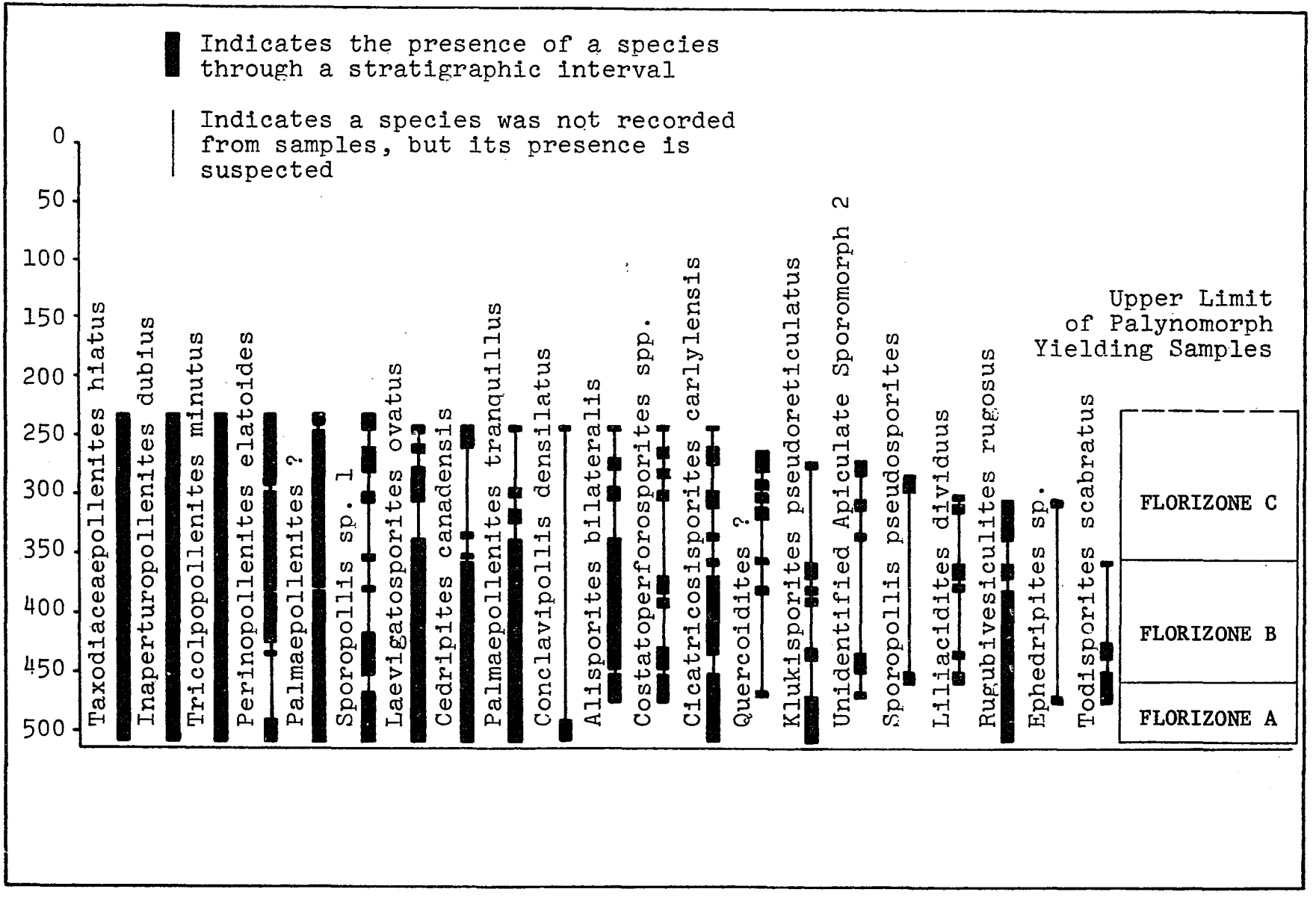

Figure 6. Vertical distribution of biostratigraphically important miospore species in the Boykin core hole.

lowest sample taken from the Boykin core. Florizone A can be recognized by the first appearance of:

Todisporites scabratus,

Unidentified Apiculate Sporomorph 2,

Costatoperforosporites spp.,

Alisporites bilateralis,

Ephedripites sp.,

Liliacidites dividuus,

Sporopollis pseudosporites,

Quercoidites ?

Throughout their range in Florizone A, the following species increased in frequency of occurrence with an increase in depth in both cores:

Todisporites scabratus,

Unidentified Apiculate Sporomorph 2,

Klukisporites pseudoreticulatus,

Costatoperforosporites spp.,

Cicatricosisporites carlylensis,

Alisporites bilateralis,

Ephedripites sp.,

Palmaepollenites ?,

Tricolpopollenites minutus.

None of the biostratigraphically important species displayed frequencies of occurrence which decreased downward through Florizone A. However, the frequency of occurrence of the following nine species varied from core to core, and changes in their relative abundance cannot be used to characterize this florizone:

Laevigatosporites ovatus,

Inaperturopollenites dubius,

Taxodiaceaepollenites hiatus,

Perinopollenites elatoides,

Rugubivesiculites rugosus,

Cedripties canadensis,

Palmaepollenites tranquillus,

Sporopollis sp. 1,

Quercoidites ?

Florizone B is located between 366 and 466 feet below the surface in the Boykin core, and between 293 and 375 feet in the Webb core. Other than the fact that all of the miospore taxa listed in Table XI ranged throughout these limits, it is impossible to further characterize this florizone on the basis of changes in frequency of occurrence. The location-specific nature of the prediction equations does not allow recognition of a trend which dominated the frequency of occurrence of the biostratigraphically important miospore species within Florizone B.

The upper limit of Florizone C could not be established, as none of the lithologic units sampled above 235 feet in the Boykin core, nor above 128 feet in the Webb core yielded palynomorphs. From samples within this florizone, the following miospore species were last observed in both cores:

Todisporites scabratus,

Klukisporites psuedoreticulatus,

Costatoperforosporites spp.,

Cicatricosisporites carlylensis,

Rugubivesiculites rugosus,

Alisporites bilateralis,

Ephedripites sp.,

Liliacidites dividuus,

Palmaepollenites tranquillus,

Conclavipollis densilatus,

Quercoidites ?

Of the biostratigraphically important miospore species which ranged into or through Florizone C, the prediction equations for Costatoperforosporites spp., Rugubivesiculites rugosus, Liliacidites dividuus, and Quercoidites ? decreased downward through the florizone, and Laevigatosporites ovatus exhibited its minimum frequency of occurrence. No other characteristic in the prediction equations of these species which extended over both cores was recognized within Florizone C.

The localized stratigraphic ranges of the biostratigraphically important species in both cores can be summarized as follows:

1) species which ranged throughout all palynomorph-yielding samples,

   Laevigatosporites ovatus,

   Taxodiaceaepollenites hiatus,

   Inaperturopollenites dubius,

   Perinopollenites elatoides,

   Palmaepollenites ?

   Tricolpopollenites minutus,

   Sporopollis sp. 1;

2) species which ranged throughout Florizone A, but last occurred in samples from Florizone C,

   Klukisporites pseudoreticulatus,

Cicatricosisporites carlylensis,

Rugubivesiculites rugosus,

Palmaepollenites tranquillus,

Conclavipollis densilatus;

3) species which first occurred in samples from Florizone A and ranged throughout all samples from Florizone C,

Unidentified Apiculate Sporomorph 2,

Sporopollis pseudosporites;

4) species which first occurred in Florizone A and last occurred in Florizone C,

Costatoperforosporites spp.,

Alisporites bilateralis,

Ephedripites sp.,

Liliacidites dividuus,

Quercoidites ?

Inasmuch as Florizones A and C are characterized by a decrease in the number of biostratigraphically important miospore species as compared to the number of species in Florizone B, rather than a change in miospore composition, care must be taken in positioning unknown samples into this zonation.

The ability to correlate the florizones recognized in the Boykin and Webb cores was tested by examining the palynomorph content of twenty-one samples from a third core (Cleveland No. 1). This core penetrated 70.4 feet of the Vick Formation, reportedly equivalent to the Trinity Group of Comanchian Age, and bottomed in rocks of the Paleozoic System. The equivalency of the Vick Formation to the Trinity Group was established by Monroe (1964) on the basis of "pink-lime" flakes used

to identify Comanchian rocks from the subsurface of Alabama and Mississippi. The location of the Cleveland core is shown in Figure 7.

As the samples from the Cleveland core have been correlated with the lower 100 feet of the Webb core by Monroe (1955, 1964), the palynomorphs recovered from these samples should reflect a floral composition similar to that which characterized Florizone A. Only two of the samples from the Cleveland core yielded palynomorphs. These samples represented adjacent stratigraphic intervals, 32.2 to 35.0 feet below the surface. Both samples were a micaceous, clayey silt, and contained unidentifiable dicotyledonous leaf fragments. The biostratigraphically important miospore species contained in these samples are listed in Table XII. In both the Boykin and Webb cores, Alisporites bilateralis and Costatoperforosporites spp. were first observed from samples in the lower portion of Florizone A. Rugubivesiculites rugosus and Palmaepollenites tranquillus ranged throughout Florizone A, but last occurred in Florizone C. The remaining seven species ranged throughout all palynomorph-yielding samples. Although the correlation of these samples with Florizone A requires a correlation based on the absence of selected species, there is no indication that the correlation of florizones recognized in the Boykin and Webb cores cannot be successfully recognized in other geographic locations.

Geographic variation. Only four miospore taxa displayed prediction equations which contained the same terms, with the same sign, in both the Boykin and Webb cores. These taxa are listed in Table XIII. The frequency of occurrence of the remaining taxa displayed prediction equations which either differed from core to core, or remained constant in one or both cores. In addition to the location-specific nature of

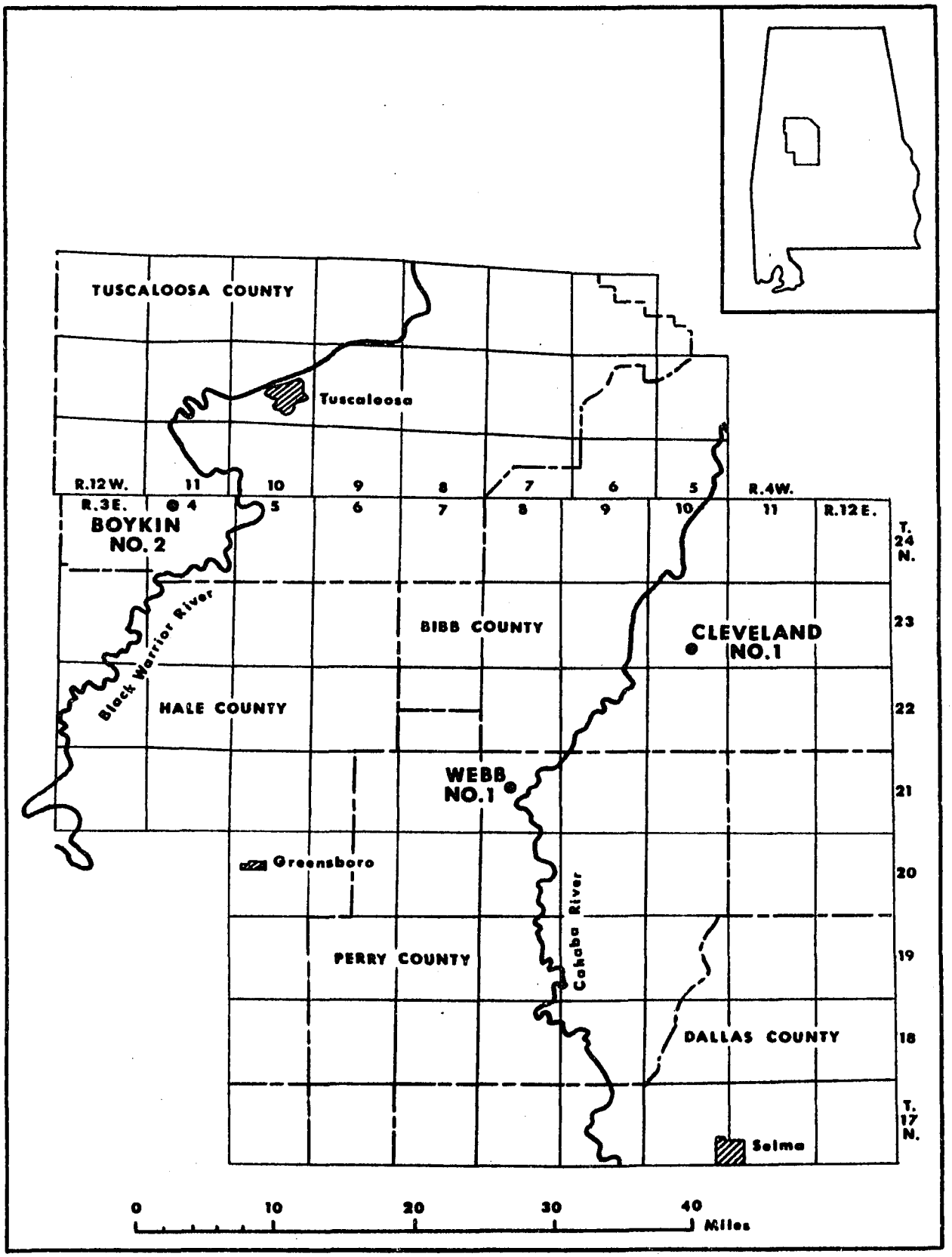

Figure 7. Portions of Tuscaloosa, Bibb, Hale, Perry and Dallas Counties, Alabama, showing the location of the Cleveland core hole.

TABLE XII

BIOSTRATIGRAPHICALLY IMPORTANT MIOSPORE SPECIES RECOVERED FROM THE CLEVELAND CORE HOLE

Costatoperforosporites spp.	*Rugubivesiculites rugosus*
Laevigatosporites ovatus	*Palmaepollenites tranquillus*
Taxodiaceaepollenites hiatus	*Palmaepollenites* ?
Inaperturopollenites dubius	*Tricolpopollenites minutus*
Cedripites canadensis	*Sporopollis* sp. 1
Alisporites bilateralis	

TABLE XIII

TAXA WHICH DISPLAY SIMILAR PREDICTION EQUATIONS IN BOTH CORES

Genus *Cicatricosisporites*	Infraturma Laevigatomonoleti
Subturma Monoletes	*Sporopollis* sp. 1

the prediction equations, the nested analyses of variance revealed fifty-four miospore taxa which displayed a significant amount of variation from core to core. These taxa are listed in Table XIV. Apparently, geographic variation in the frequency of occurrence of miospore taxa recovered from the Coker Formation in western Alabama is the rule rather than the exception.

These geographic inconsistencies can be explained by advancing any of a number of hypotheses, including the lack of a proper curvilinear expression of the data, differential rates of sedimentation, and the application of a technique to a stratigraphic interval which represents a period of time too short to reflect evolutionary change. They could also be a function of the many sources of variation associated with the production and distribution of miospores reviewed in Chapter I.

An indication that the curvilinear expression applied to the data may have been insensitive to changes in the frequency of occurrence of miospore taxa lies in the small size of the coefficient of determination for most prediction equations. This statistic is a measure of the total variation displayed by changes in the frequency of occurrence of each taxon, accounted for by the prediction equation, and can take on any value between 0 and 1. Only eight of the prediction equations in either core possessed a coefficient of determination which was greater than 0.5, whereas 105 prediction equations possessed coefficients of determination less than 0.2. A frequency table characterizing the distribution of this statistic for the prediction equations of miospore species is presented in Table XV. Clearly, the values for this coefficient are grouped toward the lower limit of their range of values.

The use of the linear, quadratic and cubic effects of depth in the

TABLE XIV

TAXA WHOSE FREQUENCY OF OCCURRENCE VARIED SIGNIFICANTLY FROM CORE TO CORE

Anteturma Sporites
Turma Charagmes
Subturma Triletes
Infraturma Laevigati
Genus Cyathidites
Cyathidites australis
Cyathidites minor
Genus Deltoidospora
Todisporites minor
Trilites sp.
Acanthotriletes sp. 1
Infraturma Muronati
Cenus Cicatricosisporites
Cicatricosisporites dorogensis
Cicatricosisporites australiensis
Cicatricosisporites venustus
Genus Laevigatosporites
Laevigatosporites ovatus
Genus Appendicisporites
Appendicisporites tricornitatus
Infraturma Tricrassati
Genus Gleicheniidites
Gleicheniidites senonicus
Genus Trilobosporites
Turma Aletes
Infraturma Psilonapiti
Taxodiaceaepollenites hiatus
Inaperturopollenites dubius
Araucariacites australis
Infraturma Disacciatrileti
Genus Cedripites
Cedripites cretaceus
Cedripites canadensis
Genus Abietineaepollenites
Abietineaepollenites microalatus
Genus Rugubivesiculites
Rugubivesiculites rugosus
Classopollis torosus
Infraturma Monocolpiti
Monosulcites chaloneri
Infraturma Triptychiti
Genus Tricolpopollenites
Tricolpopollenites minutus
Tricolpopollenites parvulus
Genus Tricolpites
Tricolpites wilsonii
Infraturma Ptychotriporiti
Genus Tricolporopollenites
Tricolporopollenites sp. 1
Infraturma Triporiti
Conclavipollis densilatus
Complexiopollis praetumescens
Unidentified Triporate Sporomorph 1
Turma Jugates

TABLE XV

FREQUENCY TABLE OF R^2 FOR PREDICTION EQUATIONS OF MIOSPORE SPECIES

CLASS VALUE	WEBB CORE HOLE				BOYKIN CORE HOLE			
	FREQUENCY	CUMULATIVE FREQUENCY	RELATIVE FREQUENCY	RELATIVE CUMULATIVE FREQUENCY	FREQUENCY	CUMULATIVE FREQUENCY	RELATIVE FREQUENCY	RELATIVE CUMULATIVE FREQUENCY
.001-.1000	16	16	.18	.18	22	22	.29	.29
.1001-.2000	36	52	.40	.58	31	53	.41	.70
.2001-.3000	21	73	.24	.82	8	61	.11	.81
.3001-.4000	6	79	.07	.89	7	68	.09	.90
.4001-.5000	2	83	.04	.93	5	73	.07	.97
.5001-.6000	2	85	.02	.95	2	75	.03	1.00
.6001-.7000	3	88	.03	.98				
.7001-.8000	1	89	.01	.99				

original regression model was an attempt to evaluate the possibility of non-linear trends in frequency of occurrence. Although this polynomial expression was used to characterize depth, there is no limit to the number of kinds of curves that can be expressed by mathematical equations. As pointed out by Steel and Torrie (1960, p. 332), it is desirable to have some idea of the basic form of the curve before selecting the appropriate curvilinear expression. This basic form can be supplied by a scatter diagram of the actual data, which, in the present study, might have resulted in a different expression for each taxon. Inasmuch as different expressions would not allow comparisons to be made between cores, or among taxa, the same curvilinear expression was used in all regression analyses.

One disadvantage in using linear, quadratic and cubic polynomials is their insensitivity to drastic or sharp changes in the direction of the dependent variable. Fox (1968) realized this problem and analyzed the absolute macrofossil abundance from measured sections in the Tanners Creek Formation (Ordovician) of southeastern Indiana with two separate regression models. One consisted of a seven-term expression to characterize long-term trends, and the other was a twenty-one term expression so that short-term variations in the abundance of macrofossils could be superimposed on long-term trends. Fox did not present these expressions, and he did not describe the method used (if any) to determine the significance of each term.

Because absolute age determinations were not available for the samples used in this investigation, and because depth of each sample was used in place of time, differential rates of sedimentation may also explain the lack of similar prediction equations for a given taxon over

both cores. Drennen (1953), Sohl (1964) and Brett (1967), all reported that the sediments of the basal Tuscaloosa Group displayed marked facies changes, and many lithologies were observed pinching out in outcrop. The time interval represented by a given stratigraphic thickness is not consistent within nor over geographic location for this area. Thus, it is not surprising that prediction equations for taxa were specific to a given location.

A third explanation which can be used to explain the location-specific nature of the prediction equations for miospore species is that the stratigraphic interval included in this study represents a time interval which is too short to detect evolutionary change. In this case, the variation displayed by miospore taxa would be nothing more than random variations superimposed on variation controlled by changes in lithology. This hypothesis cannot be explored further until the absolute age of the stratigraphic interval is known, and the evolutionary trends of phylogenetically related miospore groups are considered.

Possible provinance as suggested by reworked miospores.

Five reworked miospores were recovered from the Coker Formation in western Alabama. These miospores suggested that the sediments were derived, at least in part, from sedimentary rocks of the Pennsylvanian System. All of the reworked miospores were recovered from the Webb core, in samples which ranged between 330 and 510 feet below the surface. The reworked miospores were initially recognized by their high degree of carbonization, compared with that displayed by Cretaceous miospores. The reworked miospores belong to the following genera: Florinites, Hamiapollenites, Triquitrites, Endosporites ? and Stellisporites.

Kosanke (1964) reported that Pennsylvanian deposits of North America can be recognized by the presence of Florinites, along with other select miospore taxa.

Although Hamaipollenites is well represented in Permian rocks (Hart, 1965), Jansonius (1962), in a report on the palynology of the Permian and Triassic deposits of the Peace River area of Canada, suggested that the genus originated during the Late Pennsylvanian Period.

Kuyl, Muller and Waterbolk (1955) illustrated a form from the Carboniferous System of Europe which is morphologically similar to the one reported here as Triquitrites sp.

The camerate (?) miospore referred to Endosporites ? does not display a distinct laesurae, and a definite generic assignment cannot be made at present. However, species of Endosporites are commonly found in Devonian and Carboniferous strata, and although the genus has been recognized in Permian rocks by Hart (1963), no species have been described from the Permian System.

Alpern (1958) originally described the genus Stellisporites from the Wesphalean D of Europe.

The evidence cited above indicates that at least a portion of the Tuscaloosa Group of western Alabama might have been derived by reworking from Pennsylvanian sedimentary rocks.

V. SUMMARY AND DISCUSSION

A review of the sources of variation which contribute to the variation of palynological assemblages is presented in Chapter I. The effect of these sources could seriously bias palynofloral correlations, thus, every attempt should be made to recognize and remove the effect of as many of the sources as possible.

In the present investigation, the frequency of occurrence of palynomorph taxa contained in two samples from each of sixty-four lithologic units distributed throughout two cores of the Coker Formation in western Alabama, were analyzed using two statistical techniques. Variance components obtained from a nested analysis of variance were used to compare the variation among samples with that introduced during the preparation of slides. A backward elimination regression technique was used to recognize those miospores whose frequency of occurrence was controlled by changes in lithology, represented by median grain size and sorting coefficient, and those controlled by time, represented by changes in depth.

The results of the nested analyses of variance indicated that greater variation was displayed among slides prepared from the same sample than among samples prepared from the same lithologic unit. The effects of changes in regions, evironments and/or lithologies on the frequency of occurrence of a palynomorph taxon is rarely differentiated from the combined variation introduced through inconsistent laboratory procedures and inherent variation displayed by the frequency of occur-

rence of that taxon. Therefore, these two sources of variation combine to produce a "residual error term." As the variation displayed among different regions, environments and/or lithologies must be compared to this residual error term for evaluating differences, every effort should be made to reduce the residual error term as much as possible. The results of the nested analyses of variance presented here indicated that this effort should be directed toward controlling the variation among slides prepared from the same sample. This control of slide-to-slide variation can be achieved by: (1) refining the techniques employed in slide preparation and/or, (2) using more slides to characterize each sample.

Davis (1965, 1966) recommended the use of a magnetic stirrer for at least five minutes, set at a speed that will produce turbulence rather than a strong vortex, to produce a homogeneous suspension from which slides are prepared. She further recommended (1966) that the transfer of miospores from suspension to the slides be made as quickly as possible to avoid differential settling. Although Davis' (1965, 1966) recommendations concerned the preparation of slides for use in absolute miospore determinations, it would be advantageous, in view of the results of the present investigation, to exercise similar care and effort in the preparation of slides for any type of palynological study.

Increasing the number of slides per sample will provide a more reliable estimate of the mean number of grains per slide for a given taxon by reducing the standard error of that estimate. When a constant number of palynomorph grains are counted on each slide prepared from the same sample, the variance displayed by the frequency of occurrence of a given palynomorph taxon from slide to slide is δ^2, while the vari-

ance of the population of sample means from which this sample mean was drawn is $\frac{\sigma^2}{n}$, where n is the number of slides upon which counts were made. Therefore, an increase in the number of slides per sample would decrease the standard error of the mean number of grains per slide, and provide a more reliable estimate of the true population mean.

Those miospore species whose frequency of occurrence was partially or totally controlled by changes in sorting coefficient generally increased in relative abundance with a unit increase in sorting coefficient. Therefore, the frequency of occurrence of these species partially reflected the degree of sorting of the sediment in which they were found.

Although the number of lithologically controlled miospore species that increased in relative abundance with a 1 mm increase in median size was the same as those that decreased, those miospores which increased occurred in lithologies with a smaller median grain size than those which decreased. This suggested that a median grain size exists in which the frequency of occurrence of associated palynomorphs is not controlled by median grain size.

The consistency of the results of analyses performed on lithologically controlled miospores indicated that the lithologic controls exerted on miospore species can be characterized regardless of the morphological differences among them.

The concurrent ranges of twenty-one miospore species whose frequency of occurrence was controlled only by changes in depth, were used to establish three florizones which were correlated between the cores.

The number of these biostratigraphically important species was maximized in the middle florizone, and decreased in the florizones stratigraphically higher and lower. It cannot be determined if these decreases represented evolutionary changes or reflected a floral migration in response to increased selection pressure. However, they probably represented synchronous events over a localized geographic area. Therefore, correlation of these florizones represented chronostratigraphic correlations as well as biostratigraphic correlations.

Five miospores recovered from within a 180 foot interval of the Webb core were considered to have been reworked from deposits of the Pennsylvanian System. Thus, at least part of the Tuscaloosa Group consists of sediment derived from Pennsylvanian rocks.

In summary, it should be pointed out that the reliability of biostratigraphic correlations based solely on similarities in miospore composition of palynological assemblages has recently been questioned. In this investigation, statistical techniques were applied to palynological data to determine where the greater variation was introduced during the preparation of palynological sample, and to illustrate one technique for removing lithologically controlled taxa from biostratigraphic consideration. This "filtering" of palynofloral data led to biostratigraphic correlation based on concurrent ranges of a reduced number of taxa, but these taxa were the most reliable biostratigraphic indicators, as their relative abundance was controlled only by depth in two geographic locations.

Examination of the variation introduced during laboratory procedures, suggested that the reliability of palynological investigations could be increased by improving the techniques employed in the prepara-

tion of slides.

The regression technique applied to the palynological data from the Coker Formation of western Alabama is one of several methods for evaluating the effect of changes in regions, environments, and/or lithologies, on the variation displayed by palynological assemblages. In any palynofloral analysis, the choice of a statistical design is dependent upon the manner in which regions, environments and lithologies are combined, and on the level of measurement attained for time.

An increase in the application of statistical designs should result in more accurate biostratigraphic correlations, because it identifies and removes from consideration those palynomorphs which represent environmental controls.

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EXPLANATION OF PLATE 1

(all figures magnified 750X)

Figures 1, 2. *Calamospora mesozoica* Couper 1953.

1. Boykin No. 2, 248.0'-250.0'; assemblage no. 6429-2, 46.5 x 99.4; proximal polar view.
2. Boykin No. 2, 245.4'-246.0'; assemblage no. 6199-3, 45.7 x 107.1; proximal polar view.

Figures 3-6. *Cyathidites minor* Couper 1953.

3. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-1, 41.1 x 107.0; proximal polar view.
4. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 45.3 x 109.7; proximal polar view.
5. Boykin No. 2, 348.0'-350.5'; assemblage no. 6423-2, 37.7 x 103.1; proximal polar view.
6. Boykin No. 2, 320.0'-331.0'; assemblage no. 6271-4, 35.0 x 103.3; proximal polar view.

Figures 7-9. *Divisisporites* sp.

7. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-2-1, 35.6 x 114.6; proximal polar view.
8. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-2-1, 46.4 x 118.7; proximal polar view, polar focus.
9. Same specimen as in Figure 8, equatorial focus.

Figures 10-12. Cyathidites australis Couper 1953.

10. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-1, 35.4 x 104.1' proximal polar view.
11. Webb No. 1, 238.8'-248.0'; assemblage no. 6388-3, 42.2 x 106.6; proximal polar view.
12. Webb No. 1, 259.2'-264.0'; assemblage no. 6407-3, 44.2 x 113.4; proximal polar view.

Figures 13-15. Triplanosporites sinuosus Krutzsch 1952.

13. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-2, 47.5 x 120.3; oblique proximal polar view, equatorial focus.
14. Same specimen as in Figure 13, polar focus.
15. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-3, 43.3 x 115.3; equatorial focus.

Figure 16. Leiotriletes paramaximus Krutzsch 1952.

16. Webb No. 1, 227.0'-230.0'; assemblage no. 6433-2, 41.5 x 113.0; proximal polar view.

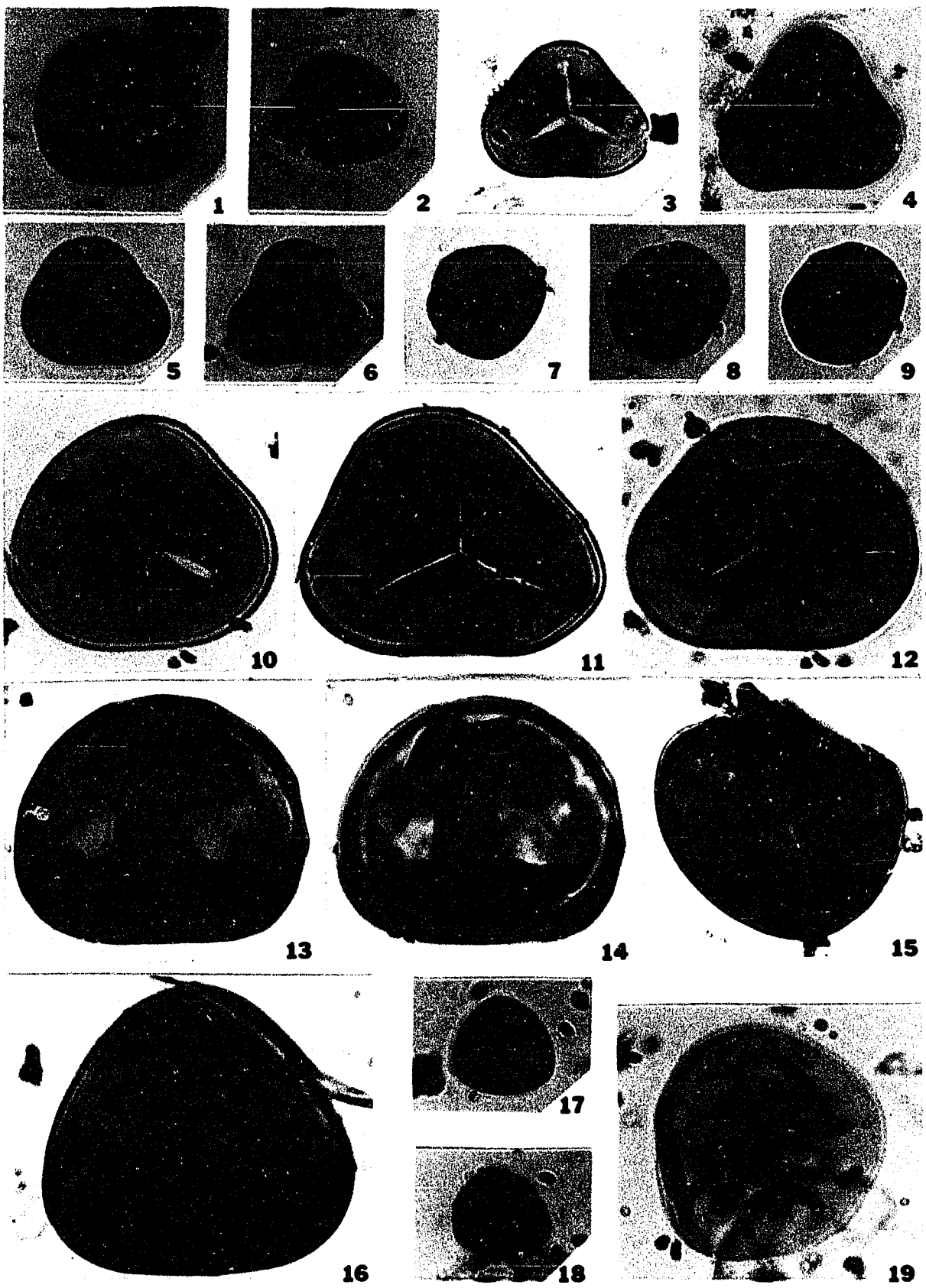
Figures 17, 18. Stereisporites antiquasporites (Wilson and Webster 1946) Dettmann 1963.

17. Webb No. 1, 299.6'-311.0'; assemblage no. 6224-4, 44.7 x 105.5; proximal polar view.
18. Boykin No. 2, 345.1'-348.5'; assemblage no. 6402-4, 32.8 x 111.6; proximal polar view; note biologic or chemical corrosion of exine.

Figure 19. Undulatisporites undulapolus Brenner 1963.

19. Webb No. 1, 435.5'-439.5'; assemblage no. 6284-4, 31.8 x 104.8; proximal polar view.

PLATE 1



EXPLANATION OF PLATE 2

(all figures magnified 750X)

Figure 1. *Undulatisporites* sp.

1. Boykin No. 2, 248.0'-250.0'; assemblage no. 6430-2, 44.9 x 105.2; proximal polar view.

Figures 2, 3. *Deltoidospora hallii* Miner 1935.

2. Webb No. 1, 282.0'-286.0'; assemblage no. 6396-3, 45.9 x 115.4; oblique proximal polar view.
3. Boykin No. 2, 352.0'-354.0'; assemblage no. 6423-2, 26.6 x 108.5; oblique proximal polar view.

Figures 4-7. *Todisporites minor* Couper 1953.

4. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-4, 27.6 x 120.2; proximal polar view.
5. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 42.6 x 113.1; proximal polar view.
6. Webb No. 1, 227.0'-230.0'; assemblage no. 6433-2, 37.8 x 116.2; proximal polar view.
7. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-4, 42.4 x 103.1; proximal polar view.

Figure 8. *Deltoidospora juncta* (Kara-Murza 1961) Singh 1964.

8. Webb No. 1, 248.0'-261.0'; assemblage no. 6172-3-1, 36.1 x 102.6; proximal polar view.

Figure 9. Plicifera delicata (Bolkhovitina 1953) Bolkhovitina 1967.

9. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-3, 40.0 x 109.5; proximal polar view.

Figure 10. Todisporites scabratus Groot and Groot 1962.

10. Boykin No. 2, 367.7'-369.0'; assemblage no. 6280-1, 29.3 x 111.9; oblique equatorial view.

Figure 11. Dictyophyllidites cf. D. harrisii Couper 1953.

11. Boykin No. 2, 445.3'-447.6'; assemblage no. 6272-3, 32.6 x 109.0; proximal polar view.

Figures 12-15. Trilites sp.

12. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-2, 31.5 x 107.7; proximal polar view.

13. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 45.2 x 110.3; proximal polar view.

14. Webb No. 1, 366.8'-369.8'; assemblage no. 6412-3, 26.2 x 106.4; both specimens in proximal polar view.

15. Boykin No. 2, 345.1'-346.4'; assemblage no. 6402-2, 36.5 x 109.8; proximal polar view.

Figure 16. Unidentified Laevigate Sporomorph 1.

16. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-3, 42.2 x 105.5; proximal polar view.

Figure 17. Acanthotriletes levidensis Balme 1957.

17. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-1, 39.0 x 106.2; proximal polar view.

Figures 18, 19. Acanthotriletes varispinosus Pocock 1962.

18. Boykin No. 2, 367.7'-369.0'; assemblage no. 6280-3, 27.3 x 107.0; proximal polar view.

19. Boykin No. 2, 386.8'-388.1'; assemblage no. 6240-3, 41.6 x 113.7; distal polar view.

Figure 20. Unidentified Laevigate Sporomorph 2.

20. Boykin No. 2, 249.2'-259.2'; assemblage no. 6279-4, 47.8 x 104.2; proximal polar view.

Figures 21, 22. Acanthotriletes sp. 1.

21. Webb No. 1, 277.2'-282.0'; assemblage no. 6403-4, 44.4 x 105.1, proximal polar view.

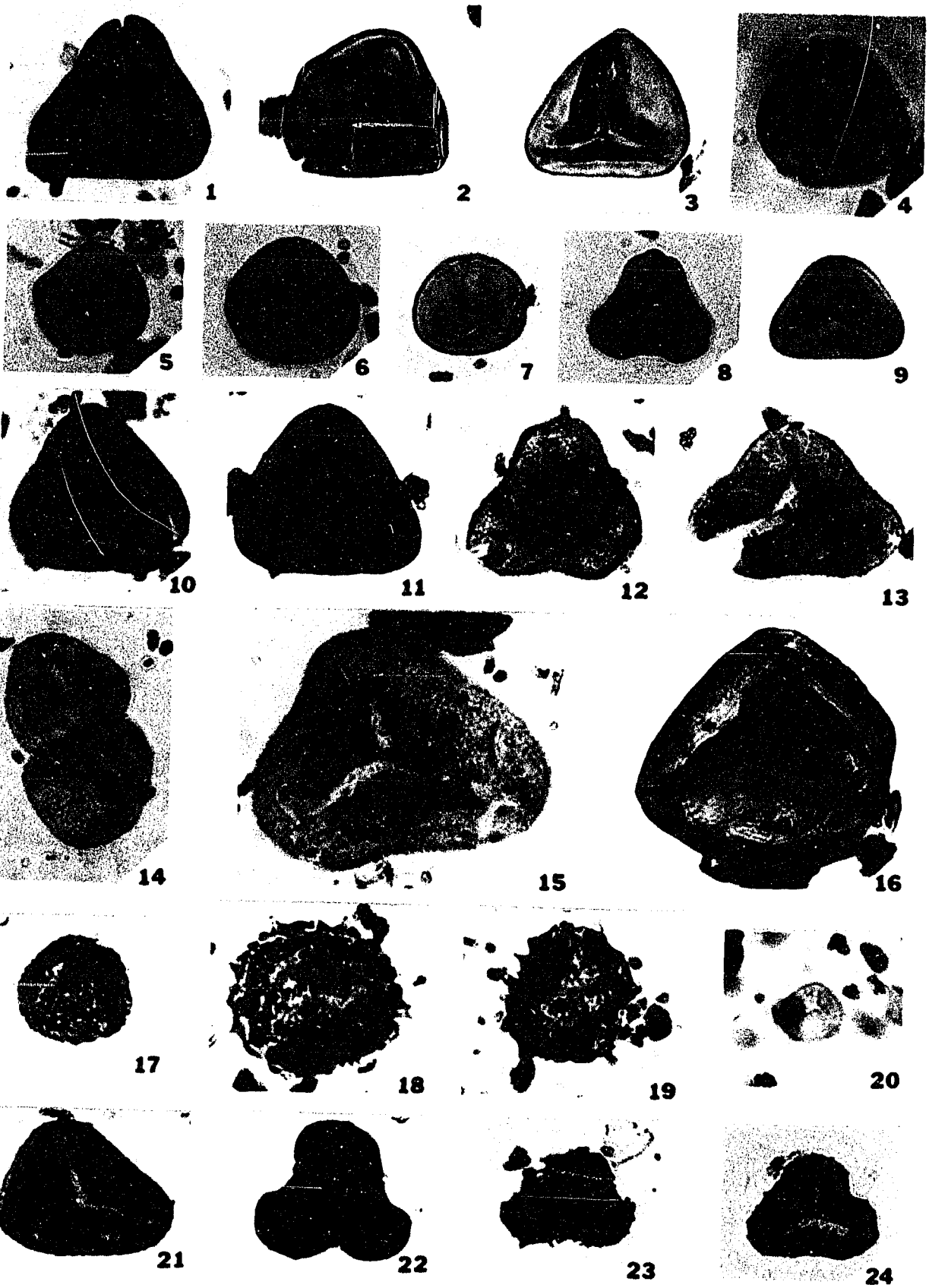
22. Webb No. 1, 452.7'-454.8'; assemblage no. 6238-1, 39.2 x 107.0; proximal polar view.

Figures 23, 24. Acanthotriletes sp. 2.

23. Webb No. 1, 422.0'-427.0'; assemblage no. 6200-1, 35.2 x 109.0; proximal polar view.

24. Webb No. 1, 422.0'-427.0'; assemblage no. 6200-1, 45.5 x 101.3; proximal polar view.

PLATE 2



EXPLANATION OF PLATE 3

(all figures magnified 750X)

Figures 1, 2. Ornamentifera confossa (Hedlund 1966) nov. comb.

1. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 39.2 x 119.2; proximal polar view.
2. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-3, 39.6 x 107.4; proximal polar view.

Figures 3-5. Unidenrified Apiculate Sporomorph 1.

3. Boykin No. 2, 12.0'-14.0'; assemblage no. 6432-4, 28.7 x 100.2; proximal polar view.
4. Webb No. 1, 282.0'-286.0'; assemblage no. 6396-4, 43.7 x 101.8; proximal polar view.
5. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-1, 42.1 x 118.3; proximal polar view.

Figure 6. Unidentified Apiculate Sporomorph 2.

6. Webb No. 1, 299.6'-311.0'; assemblage no. 6263-2, 46.1 x 107.7; proximal polar view.

Figure 7. Unidentified Apiculate Sporomorph 3.

7. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 32.6 x 116.4; proximal polar view.

Figures 8-10. Cicatricosisporites dorogensis R. Potonié and Gelletich 1933.

8. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6169-3-1, 41.5 x 118.9; proximal polar view.
9. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6331-2, 38.7 x 111.4; distal polar view.
10. Boykin No. 2, 436.7'-444.0'; assemblage no. 6281-1, 34.1 x 116.4; polar view.

Figures 11, 12. Cicatricosisporites australiensis (Cookson 1953) R. Potonié 1956.

11. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-3-1, 29.5 x 113.9; proximal polar view.
12. Webb No. 1, 282.0'-286.0'; assemblage no. 6396-4, 35.5 x 110.0; distal polar view.

Figures 13, 14. Cicatricosisporites carlylensis Pocock 1962.

13. Boykin No. 2, 393.3'-398.0'; assemblage no. 6361-1, 37.3 x 111.9; proximal polar view.
14. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-3-1, 29.5 x 119.6; distal polar view.

Figure 15. Cicatricosisporites aralica (Bolkhovitina 1961) Brenner 1963.

15. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-4, 30.9 x 116.9; proximal polar view.

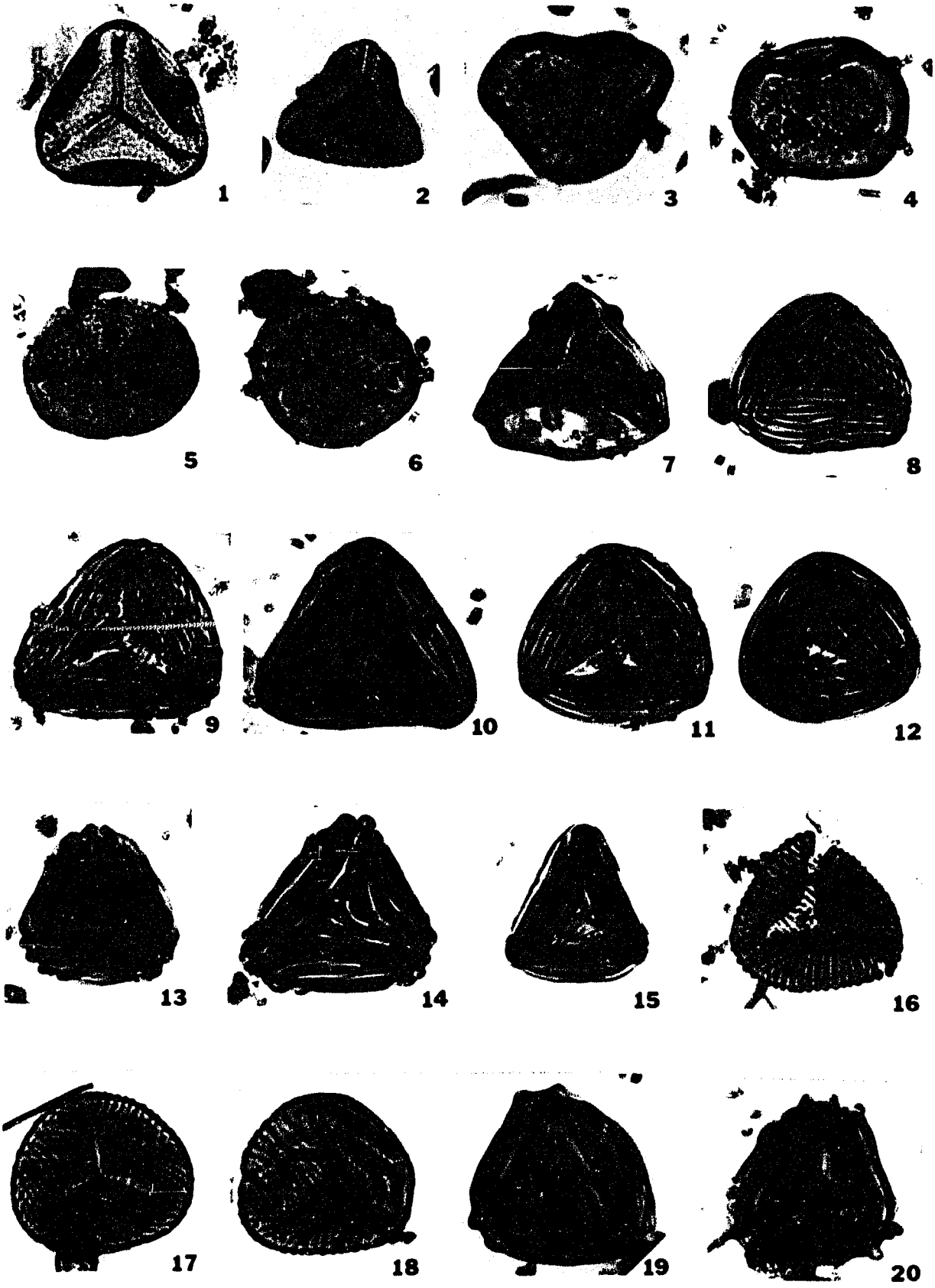
Figures 16-18. Cicatricosisporites venustus Deák 1963.

16. Boykin No. 2, 343.1'-345.1'; assemblage no. 6278-4, 44.8 x 106.1; proximal polar view.
17. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-2, 42.9 x 103.4; distal polar view.
18. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 46.2 x 109.3; proximal polar view.

Figures 19, 20. Cicatricosisporites lucifer Hughes and Moody-Stuart 1967.

19. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6169-6-1, 28.2 x 101.8; proximal polar view.
20. Boykin No. 2, 436.7'-444.0'; assemblage no. 6281-1, 29.5 x 115.1; distal polar view.

PLATE 3



EXPLANATION OF PLATE 4

(all figures magnified 750X)

Figures 1-3. Cicatricosisporites coconinoensis Agasie 1969.

1. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-2, 33.3 x 109.2; proximal polar view.
2. Webb No. 1, 330.0'-336.0'; assemblage no. 6341-3, 44.2 x 107.8; equatorial view.
3. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-4, 45.8 x 111.8; proximal polar view.

Figure 4. Unidentified Muronate Sporomorph 2.

4. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 39.4 x 110.3; proximal polar view.

Figure 5. Cicatricosisporites sp.

5. Webb No. 1, 292.7'-296.1'; assemblage no. 6324-2, 27.7 x 102.8; proximal polar view.

Figures 6, 7. Lygodioisporites cf. L. perverrucatus Couper 1958.

6. Webb No. 1, 292.7'-296.1'; assemblage no. 6181-2, 40.0 x 103.1; distal polar view.
7. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 48.5 x 119.2; distal polar view.

Figures 8-10. Chomotriletes fragilis Pocock 1962.

8. Boykin No. 2, 436.7'-444.0'; assemblage no. 6281-2, 33.2 x 106.0; polar view.
9. Webb No. 1, 299.6'-311.0'; assemblage no. 6224-4, 45.7 x 107.1; polar view.
10. Boykin No. 2, 436.7'-444.0'; assemblage no. 6281-1, 34.1 x 116.4; polar view.

Figures 11, 12. Rugulatisporites caperatus van Hoeken-Klinkenberg 1964.

11. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 42.8 x 105.7; proximal polar view.
12. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 31.4 x 101.7; distal polar view.

Figures 13, 14. Microreticulatisporites pseudofoveolatus Deák 1964.

13. Boykin No. 2, 245.4'-246.0'; assemblage no. 6199-3, 45.7 x 107.5; proximal polar view.
14. Boykin No. 2, 457.0'-459.0'; assemblage no. 6236-4, 45.3 x 104.8; proximal polar view. Note biological or chemical degradation of exine.

Figures 15, 16. Foveotriletes parviretus (Balme 1957) Dettmann 1963.

15. Webb No. 1, 299.6'-311.0'; assemblage no. 6263-1, 47.3 x 101.2; oblique proximal polar view.

16. Cleveland No. 1, 33.0'-34.6'; assemblage no. 6331-4, 33.2 x 112.7; oblique proximal polar view.

Figures 17, 18. Foveotriletes subtriangularis Brenner 1963.

17. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6169-1-1, 31.9 x 106.1; proximal polar view.
18. Boykin No. 2, 393.3'-398.0'; assemblage no. 6361-1, 37.3 x 111.9; part of the exine has been torn away, revealing the internal structure of the fovae.

Figures 19-22. Klukisporites pseudoreticulatus Couper 1958.

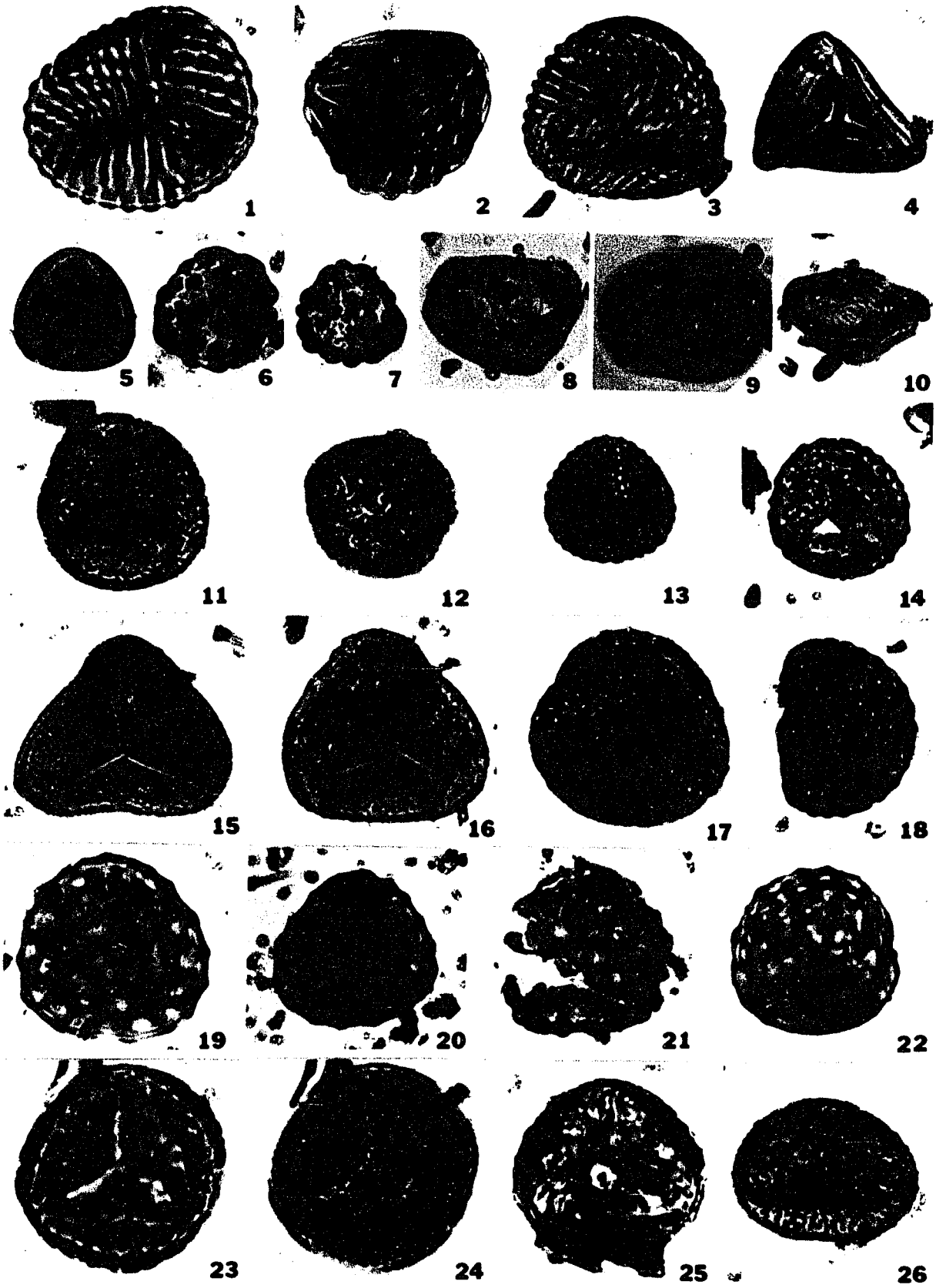
19. Boykin No. 2, 367.7'-369.0'; assemblage no. 6280-4, 29.6 x 108.9; proximal polar view.
20. Boykin No. 2, 393.3'-398.0'; assemblage no. 6361-3, 41.0 x 105.1; distal polar view.
21. Boykin No. 2, 386.8'-388.1'; assemblage no. 6265-5, 33.3 x 108.8; distal polar view.
22. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-3, 34.2 x 109.7; oblique equatorial view.

Figures 23-26. Camarozonosporites insignis Norris 1967.

23. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-1, 19.9 x 99.4; distal polar view, equatorial focus.
24. Same specimen as in Figure 23, polar focus.
25. Boykin No. 2, 445.3'-447.6'; assemblage no. 6293-1, 41.3 x 104.5; proximal polar view, equatorial focus.

26. Webb No. 1, 128.8'-135.5'; assemblage no. 6264-3, 33.2 x 115.0; proximal polar view, equatorial focus.

PLATE 4



EXPLANATION OF PLATE 5

(all figures magnified 750X)

Figures 1, 2. Retitriletes pluricellulus Pierce 1961.

1. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 32.9 x 105.9; polar view.
2. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-1, 34.3 x 102.3; polar view.

Figures 3, 4. Retitriletes cenomanianus Agasie 1969.

3. Boykin No. 2, 369.0'-378.1'; assemblage no. 6230-1, 47.1 x 107.9; polar view, polar focus.
4. Same specimen as in Figure 3, equatorial focus.

Figures 5-7. Costatoperforosporites spp.

5. Boykin No. 2, 369.0'-378.1'; assemblage no. 6230-4, 37.3 x 107.7; distal polar view.
6. Webb No. 1, 299.6'-311.0'; assemblage no. 6224-4, 34.6 x 106.9; proximal polar view.
7. Boykin No. 2, 436.7'-444.0'; assemblage no. 6281-1, 31.4 x 108.3; distal polar view.

Figure 8. Taurocusporites segmentatus Stover 1962.

8. Boykin No. 2, 12.0'-14.0'; assemblage no. 6432-4, 28.7 x 100.2; proximal polar view.

Figure 9. Taurocusporites reduncus (Bolkhovitina 1953) Stover 1962.

9. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6169-6-1, 33.3 x 107.9; distal polar view.

Figure 10. Taurocusporites sp.

10. Boykin No. 2, 386.0'-388.1'; assemblage no. 6265-2, 30.5 x 116.5; distal polar view.

Figure 11. Unidentified Muronate Sporomorph 4.

11. Boykin No. 2, 386.8'-388.1'; assemblage no. 6265-3, 28.9 x 110.9; proximal polar view.

Figures 12, 13. Unidentified Muronate Sporomorph 3.

12. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 36.4 x 118.1; proximal polar view.

13. Boykin No. 2, 246.0'-246.4'; assemblage no. 6391-2, 32.3 x 105.2; proximal polar view.

Figure 14. Unidentified Muronate Sporomorph 5.

14. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-2, 40.2 x 103.3; proximal polar view.

Figure 15. Unidentified Muronate Sporomorph 6.

15. Boykin No. 2, 369.0'-378.1'; assemblage no. 6230-1, 46.9 x 106.5; proximal polar view.

Figure 16. Unidentified Muronate Sporomorph 7.

16. Webb No. 1, 299.6'-311.0'; assemblage no. 6236-4, 38.9 x 111.3; oblique proximal polar view.

Figure 17. Unidentified Muronate Sporomorph 8.

17. Boykin No. 2, 366.0'-367.7'; assemblage no. 6329-5, 40.6 x 105.2; proximal polar view.

Figures 18, 19. Laevigatosporites ovatus Wilson and Webster 1946.

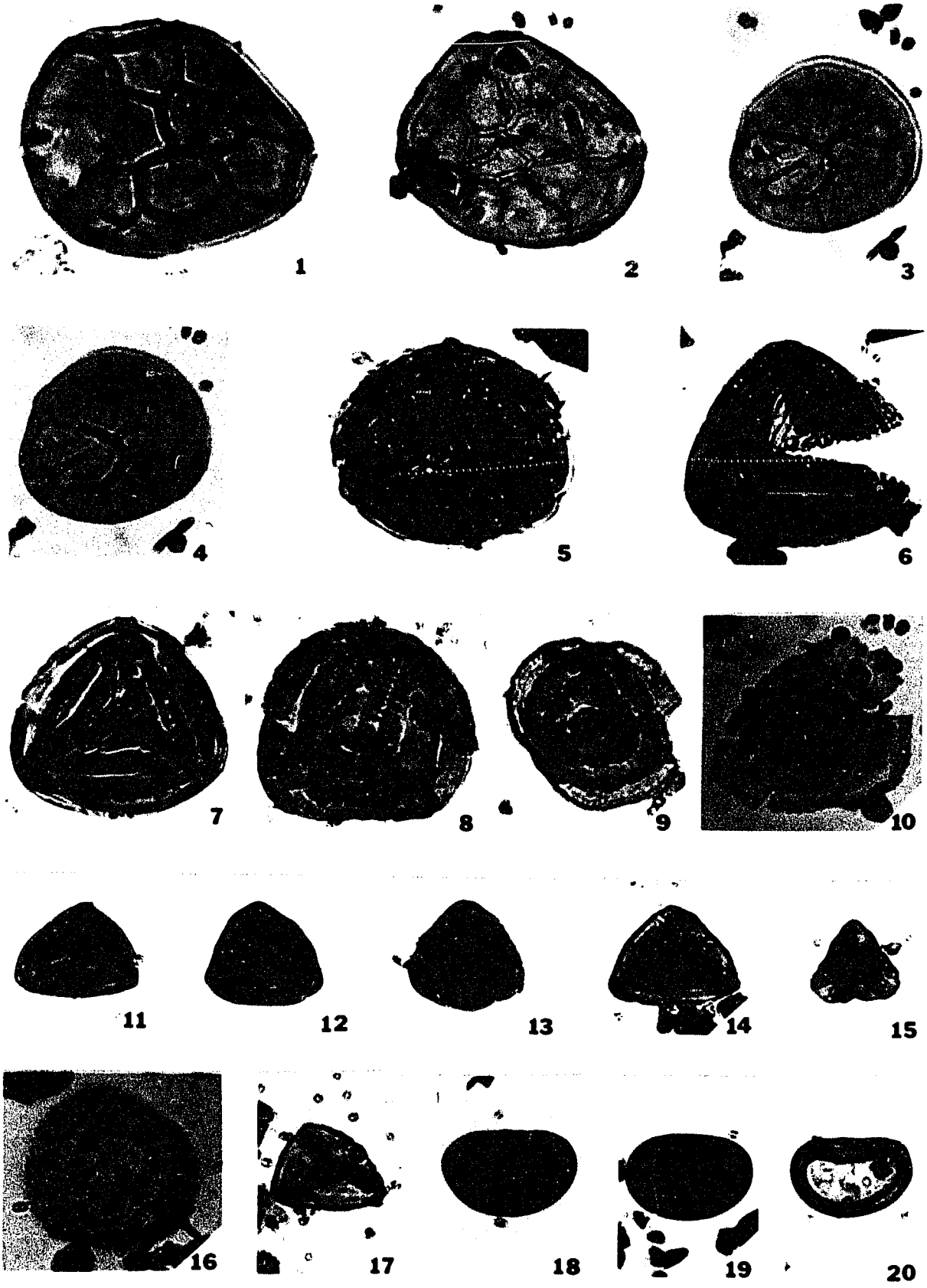
18. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-2-1, 39.9 x 109.0; equatorial view.

19. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 32.1 x 109.0; oblique proximal polar view.

Figure 20. Laevigatosporites albertensis Rouse 1957.

20. Webb No. 1, 299.6'-311.0'; assemblage no. 6263-2, 35.7 x 108.5; equatorial view.

PLATE 5



EXPLANATION OF PLATE 6

(all figures magnified 750X)

Figure 1. Petalosporites quadrangulus Agasie 1969.

1. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 40.9 x 109.0; proximal polar view.

Figures 2, 5. Monolites intragranulosus Singh, Srivastava and Roy 1963.

2. Webb No. 1, 422.0'-427.0'; assemblage no. 6200-3, 32.9 x 117.6; oblique equatorial view.
5. Webb No. 1, 422.0'-427.0'; assemblage no. 6200-3, 40.7 x 116.6; equatorial view.

Figure 3. Verrucatosporites pseudoreticulatus Hedlund 1966.

3. Boykin No. 2, 348.0'-350.5'; assemblage no. 6424-5, 40.7 x 112.5; equatorial view.

Figure 4. Unidentified Muronate Sporomorph 1.

4. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 38.5 x 111.5; proximal polar view.

Figure 6. Lycopodiumsporites marginatus Singh 1964.

6. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 47.7 x 114.9; proximal polar view.

Figures 7, 8. *Cirratriradites teter* Norris 1967.

7. Webb No. 1, 422.0'-427.0'; assemblage no. 6200-1, 40.4 x 118.3; proximal polar view.
8. Boykin No. 2, 459.4'-466.2'; assemblage no. 6365-2, 47.7 x 107.8; proximal polar view.

Figure 9. Unidentified Zonate Sporomorph 3.

9. Webb No. 1, 299.6'-311.0'; assemblage no. 6263-2, 41.0 x 109.1; proximal polar view.

Figure 10. *Rouseisporites* sp.

10. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 39.0 x 104.2; distal polar view.

Figure 11. Unidentified Cingulate Sporomorph 1.

11. Webb No. 1, 248.0'-261.0'; assemblage no. 6172-3, 41.5 x 113.3; proximal polar view.

Figure 12. Unidentified Zonate Sporomorph 2.

12. Boykin No. 2, 445.3'-447.6'; assemblage no. 6272-4, 41.6 x 103.0; proximal polar view.

Figure 13. *Cingulatisporites levispeciosus* Pflug 1953.

13. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 34.4 x 106.8; proximal polar view.

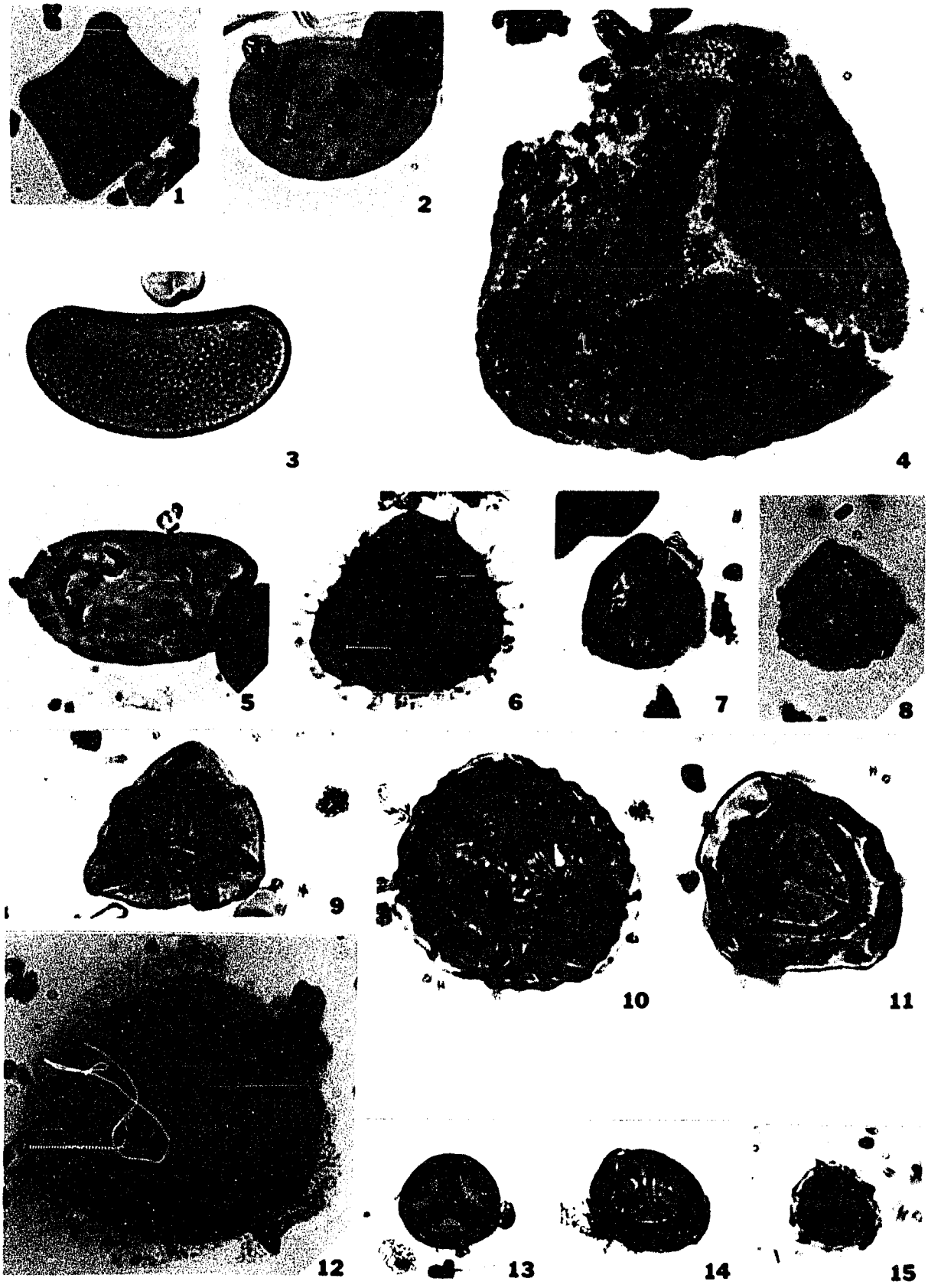
Figure 14. Cingulatisporites sp.

14. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-4, 28.7 x 113.9; proximal polar view.

Figure 15. Unidentified Cingulate Sporomorph 2.

15. Boykin No. 2, 345.1'-346.4'; assemblage no. 6249-4, 28.6 x 106.0; distal polar view.

PLATE 6



EXPLANATION OF PLATE 7

(all figures magnified 750X)

Figures 1, 2. Patellasporites tavaredensis Groot and Groot 1962.

1. Boykin No. 2, 12.0'-14.0'; assemblage no. 6432-4, 29.1 x 113.9; proximal polar view.
2. Webb No. 1, 128.8'-135.5'; assemblage no. 6264-2, 39.9 x 112.2; proximal polar view.

Figure 3. Unidentified Cingulate Sporomorph 3.

3. Webb No. 1, 128.8'-135.5'; assemblage no. 6264-4, 32.7 x 110.7; proximal polar view.

Figure 4. Unidentified Cingulate Sporomorph 4.

4. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 43.7 x 109.7; proximal polar view.

Figures 5, 6. Unidentified Cingulate Sporomorph 5.

5. Webb No. 1, 299.6'-311.0'; assemblage no. 6263-2, 37.3 x 115.1; proximal polar view.
6. Boykin No. 2, 386.8'-388.1'; assemblage no. 6265-3, 28.9 x 110.9; distal polar view.

Figures 7, 8. Appendicisporites tricornitatus Weyland and Greifeld 1953.

7. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 30.3 x 110.2; distal polar view.
8. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-2, 33,8 x 112.6; proximal polar view.

Figures 9, 10, 12. Appendicisporites unicus (Markova 1961) Singh 1964.

9. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 39.8 x 105.7; proximal polar view.
10. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 29.5 x 114.4; distal polar view.
12. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-2, 35.8 x 102.9; distal polar view.

Figure 11. Unidentified Auriculate Sporomorph 1.

11. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-2, 43.0 x 112.3; proximal polar view.

Figures 13, 14. Gleicheniidites sp.

13. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-2-1, 28.5 x 118.4; proximal polar view.
14. Webb No. 1, 506.0'0509.0'; assemblage no. 6170-3, 46.1 x 105.5; proximal polar view.

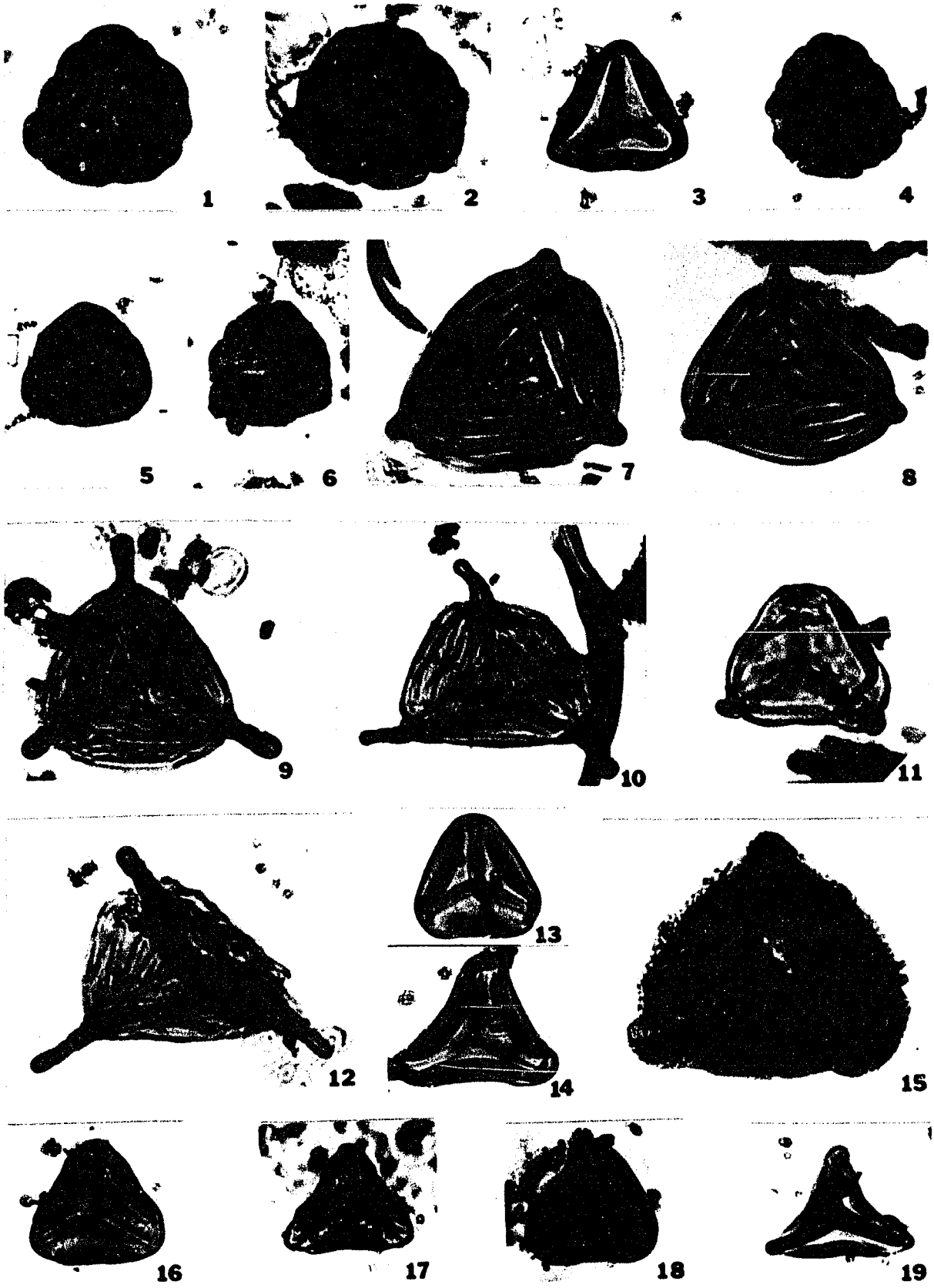
Figure 15. Appendicisporites ethmos Delcourt and Sprumont 1955.

15. Boykin No. 2, 12.0'-14.0'; assemblage no. 6431-1, 35.8 x 120.0; proximal polar view.

Figures 16-19. Gleicheniidites senonicus Ross 1949 emend. Skarby 1964.

16. Cleveland No. 1, 33.0'-34.6'; assemblage no. 6331-3, 32.7 x 107.4; proximal polar view.
17. Boykin No. 2, 386.8'-388.1'; assemblage no. 6265-5, 38.5 x 104.8; proximal polar view.
18. Cleveland No. 1, 33.0'-34.6'; assemblage no. 6331-4, 40.1 x 111.4; proximal polar view.
19. Webb No. 1, 238.8'-248.0'; assemblage no. 6388-3, 37.2 x 111.4; proximal polar view.

PLATE 7



EXPLANATION OF PLATE 8

(all figures magnified 750X)

Figures 1, 2. Trilobosporites purverulentus (Verbitskaya 1962) Dettmann 1963.

1. Boykin No. 2, 369.0'-378.1'; assemblage no. 6230-1, 39.2 x 111.0; proximal polar view.
2. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-5, 32.6 x 103.6; proximal polar view.

Figures 3, 4. Trilobosporites sp.

3. Boykin No. 2, 445.3'-447.6'; assemblage no. 6272-4, 34.6 x 102.2; proximal polar view.
4. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-5, 49.4 x 120.0; proximal polar view.

Figures 5, 6. Applanopsis dampieri (Balme 1957) Döring 1961.

5. Boykin No. 2, 248.0'-250.0'; assemblage no. 6430-4, 32.1 x 103.1; trilete form.
6. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-4, 36.1 x 108.3; alete form.

Figure 7. Uvaesporites glomeratus Döring 1965.

7. Webb No. 1, 128.8'-135.5'; assemblage no. 6264-1, 34.9 x 104.9; proximal polar view.

Figure 8. Uvaesporites cf. U. pseudocingulatus Döring 1965.

8. Webb No. 1, 350.0'-354.0'; assemblage no. 6226-5, 41.9 x 110.9; proximal polar view.

Figures 9-12. Peromonolites allenensis Brenner 1963.

9. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-4, 45.4 x 116.2, equatorial view.
10. Same specimen as in Figure 9, phase contrast lighting.
11. Webb No. 1, 267.0'-277.2'; assemblage no. 6184-3, 32.9 x 102.4; proximal polar view.
12. Webb No. 1, 282.0'-286.0'; assemblage no. 6396-4, 30.1 x 112.8; oblique polar view.

Figures 13-17. Taxodiaceaepollenites hiatus (R. Potonié 1934) Kremp 1949.

13. Boykin No. 2, 500.0'-510.0'; assemblage no. 6289-3, 38.4 x 114.9.
14. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-1, 28.3 x 107.5.
15. Boykin No. 2, 352.0'-354.0'; assemblage no. 6423-4, 28.2 x 117.6.
16. Boykin No. 2, 352.0'-354.0'; assemblage no. 6423-4, 37.6 x 104.7.
17. Boykin No. 2, 271.4'-276.0'; assemblage no. 6393-4, 41.2 x 116.2.

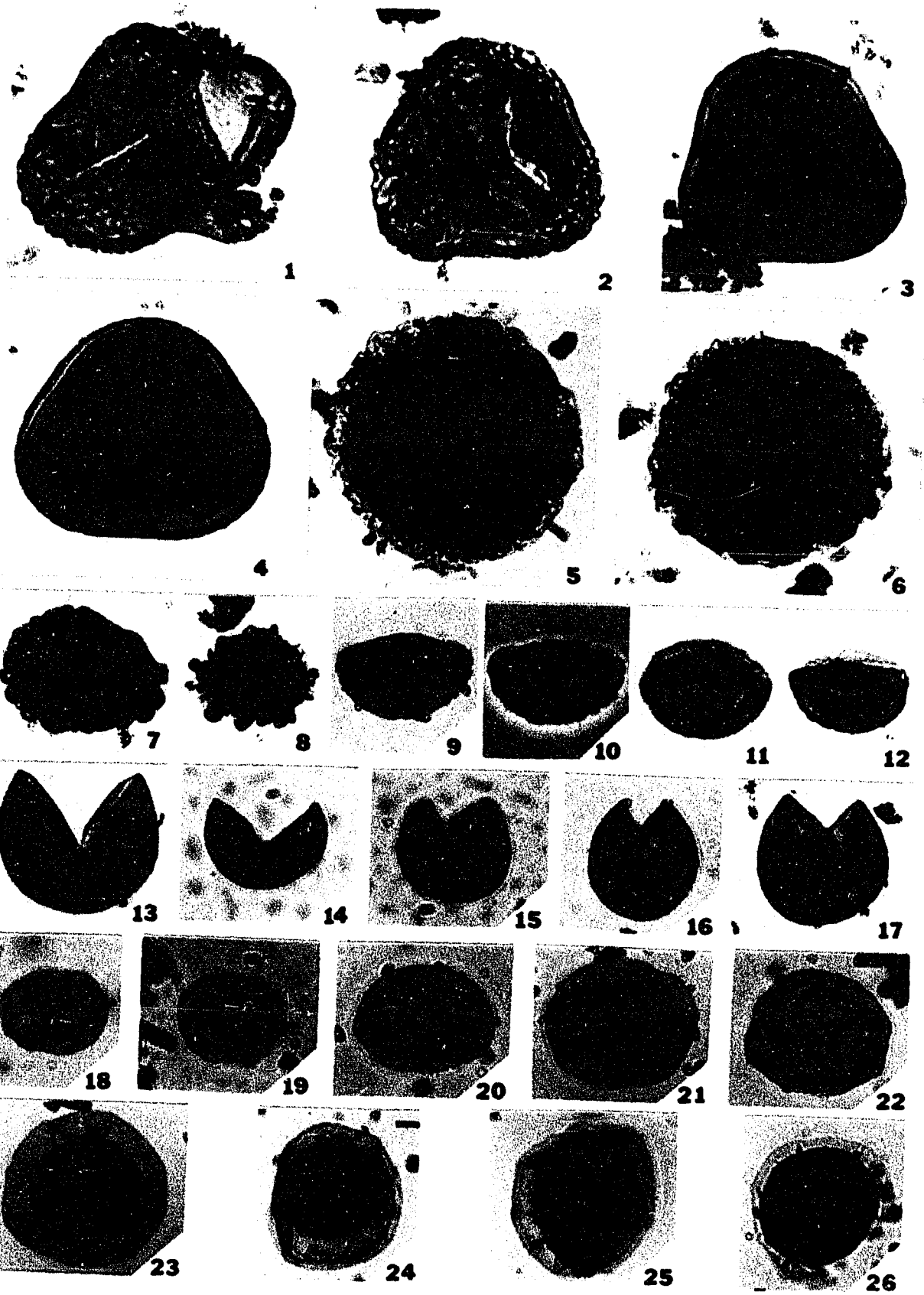
Figures 18-22. Inaperturopollenites dubius (R. Potonié and and Venitz 1934) Thomson and Pflug 1953.

18. Boykin No. 2, 320.0'-331.0'; assemblage no. 6271-4, 34.0 x 105.6.
19. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-5, 38.3 x 108.7.
20. Webb No. 1, 435.5'-439.5'; assemblage no. 6284-4, 30.4 x 104.1.
21. Webb No. 1, 336.0'-338.8'; assemblage no. 6362-2, 42.0 x 103.4.
22. Webb No. 1, 509.0'-515.5'; assemblage no. 6342-4, 31.1 x 103.0.

Figures 23-26. Perinopollenites elatoides Couper 1958.

23. Webb No. 1, 227.0'-230.0'; assemblage no. 6422-1, 35.9 x 112.7; polar view.
24. Webb No. 1, 369.8'0372.9'; assemblage no. 6259-1, 38.2 x 102.6; polar view.
25. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-4, 36.1 x 108.3; polar view.
26. Webb No. 1, 227.0'-230.0'; assemblage no. 6422-1, 35.9 x 112.7; polar view.

PLATE 8



EXPLANATION OF PLATE 9

(all figures magnified 750X)

Figure 1. Laricoidites magnus (R. Potonié 1931) R. Potonié, Thomson and Thiergart 1950.

1. Webb No. 1, 350.0'-354.0'; assemblage no. 6226-2, 40.3 x 102.3.

Figures 2, 3. Araucariacites australis Cookson 1947.

2. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 37.9 x 109.6.
3. Webb No. 1, 227.0'-230.0'; assemblage no. 6433-4, 42.0 x 101.6.

Figures 4, 5. Cedripites cretaceus Pocock 1962.

4. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-5, 46.1 x 105.5; distal polar view.
5. Boykin No. 2, 12.0'-14.0'; assemblage no. 6431-1, 48.7 x 116.3; distal polar view.

Figures 6, 7. Cedripites canadensis Pocock 1962.

6. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6169-3, 41.4 x 116.3; distal polar view.
7. Boykin No. 2, 390.0'-392.0'; assemblage no. 6408-3, 32.6 x 109.2, oblique equatorial view.

Figures 8, 9. Abietineaepollenites microalatus R. Potonié 1951.

8. Webb No. 1, 455.0'-456.2'; assemblage no. 6368-3, 38.2 x 103.2; distal polar view.
9. Webb No. 1, 455.0'-456.2'; assemblage no. 6368-3, 38.2 x 109.5; distal polar view.

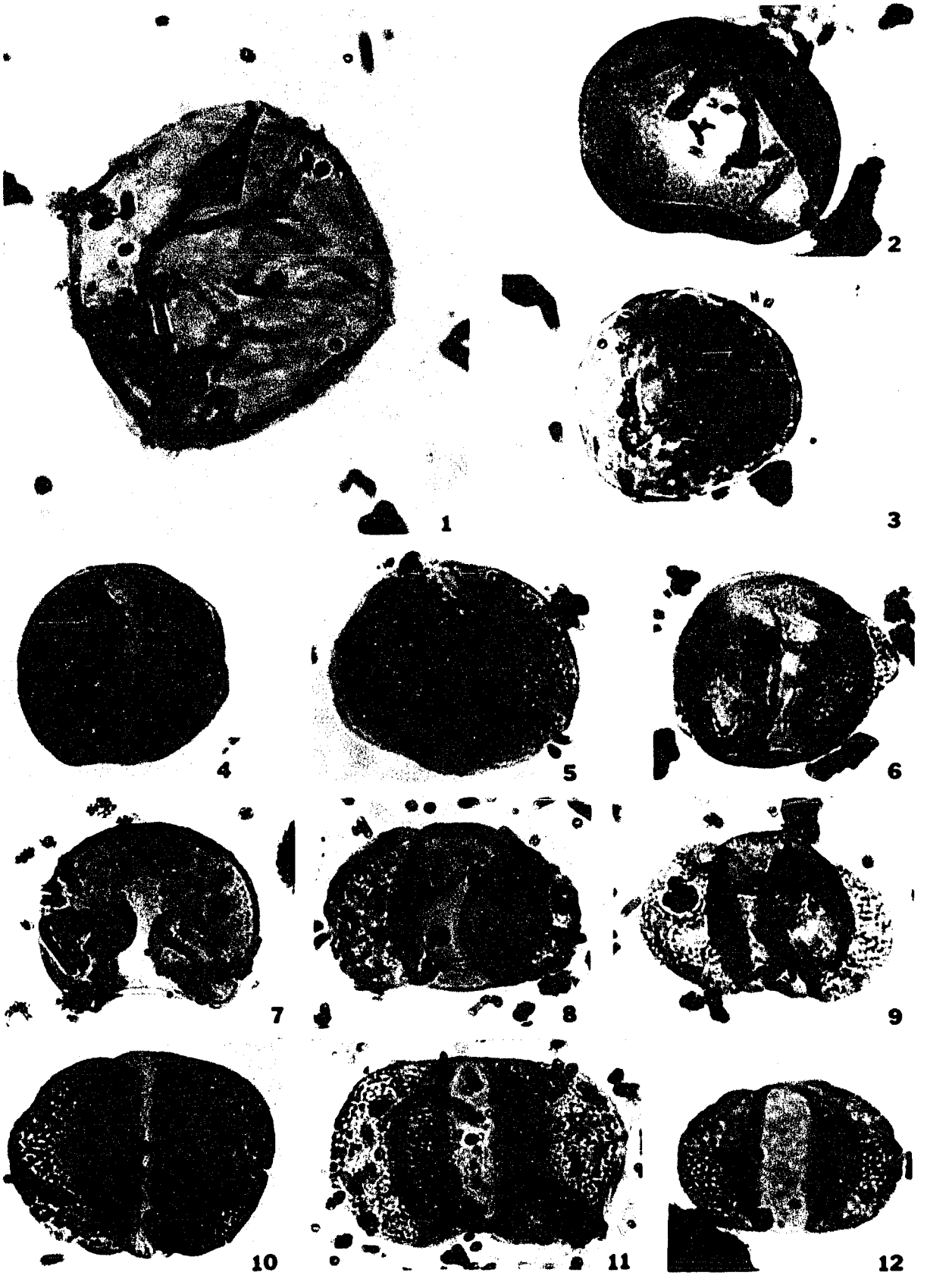
Figure 10. Abietineaepollenites microreticulatus Groot and Penny 1960.

10. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-2-1, 35.7 x 109.2; distal polar view.

Figures 11, 12. Alisporites bilateralis Rouse 1959.

11. Boykin No. 2, 436.7'-444.0'; assemblage no. 6260-1, 43.9 x 110.8; distal polar view.
12. Cleveland No. 1, 29.0'-32.2'; assemblage no. 6169-3, 38.7 x 111.2; distal polar view.

PLATE 9



EXPLANATION OF PLATE 10

(all figures magnified 750X)

Figure 1. Caytonipollenites cf. C. pallidus (Reissinger 1950) Couper 1958.

1. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-3, 40.2 x 103.5; distal polar view.

Figures 2, 3. Rugubivesiculites rugosus Pierce 1961.

2. Boykin No. 2, 314.2'-320.0'; assemblage no. 6415-5, 40.7 x 106.7; proximal polar view.
3. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-3, 40.9 x 118.3; lateral view.

Figures 4-6. Rugubivesiculites woodbinensis Hedlund 1966.

4. Boykin No. 2, 369.0'-378.1'; assemblage no. 6230-3, 46.4 x 110.4; proximal polar view.
5. Boykin No. 2, 457.0'-459.0'; assemblage no. 6236-2, 41.7 x 110.7; equatorial view.
6. Boykin No. 2, 352.0'-354.0'; assemblage no. 6423-2, 35.8 x 108.9; oblique distal polar view.

Figure 7. Unidentified Saccate Sporomorph 1.

7. Boykin No. 2, 500.0'-510.0'; assemblage no. 6290-4, 33.7 x 112.3; distal polar view.

Figure 8. Unidentified Saccate Sporomorph 3.

8. Webb No. 1, 299.6'-311.0'; assemblage no. 6224-4, 28.8 x 106.6; distal polar view.

Figure 9. Unidentified Saccate Sporomorph 2.

9. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-2, 41.0 x 113.7; distal polar view.

Figure 10. Unidentified Saccate Sporomorph 4.

10. Boykin No. 2, 445.3'-447.6'; assemblage no. 6272-3, 46.4 x 108.4; oblique distal polar view.

Figures 11-14. Classopollis torosus (Reissinger 1950) Couper 1958.

11. Boykin No. 2, 281.0'-286.6'; assemblage no. 6316-2, 37.0 x 115.6; polar view.
12. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 35.7 x 116.0; polar view.
13. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-2, 34.4 x 117.7; oblique equatorial view.
14. Webb No. 1, 455.0'-456.2'; assemblage no. 6368-2, 27.7 x 106.0; oblique equatorial view.

Figure 15. Ephedripites virginiaensis Brenner 1963.

15. Webb No. 1, 227.0'-230.0'; assemblage no. 6433-2, 35.8 x 107.9; equatorial view.

Figures 16, 17. Ephedripites dudarensis Deák 1965.

16. Boykin No. 2, 271.4'-276.0'; assemblage no. 6398-1, 29.0 x 112.3; equatorial view.

17. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-1, 42.2 x 113.2; equatorial view.

Figure 18. Welwitschiapites virgatus Deák 1965.

18. Boykin No. 2, 367.7'-369.0'; assemblage no. 6280-1, 29.4 x 111.9; equatorial view.

Figure 19. Monosulcites chaloneri Brenner 1963.

19. Webb No. 1, 422.0'-427.0'; assemblage no. 6328-3, 30.5 x 108.2; equatorial view.

Figure 20. Liliacidites dividuus (Pierce 1961) Brenner 1963.

20. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-2, 40.5 x 112.6; equatorial view.

Figures 21, 22. Ephedripites sp.

21. Boykin No. 2, 310.5'-314.2'; assemblage no. 6232-3, 37.9 x 101.1; equatorial view.

22. Boykin No. 2, 310.5'-314.2'; assemblage no. 6232-4, 34.4 x 111.6; oblique polar view.

Figure 23. Eucommiidites sp.

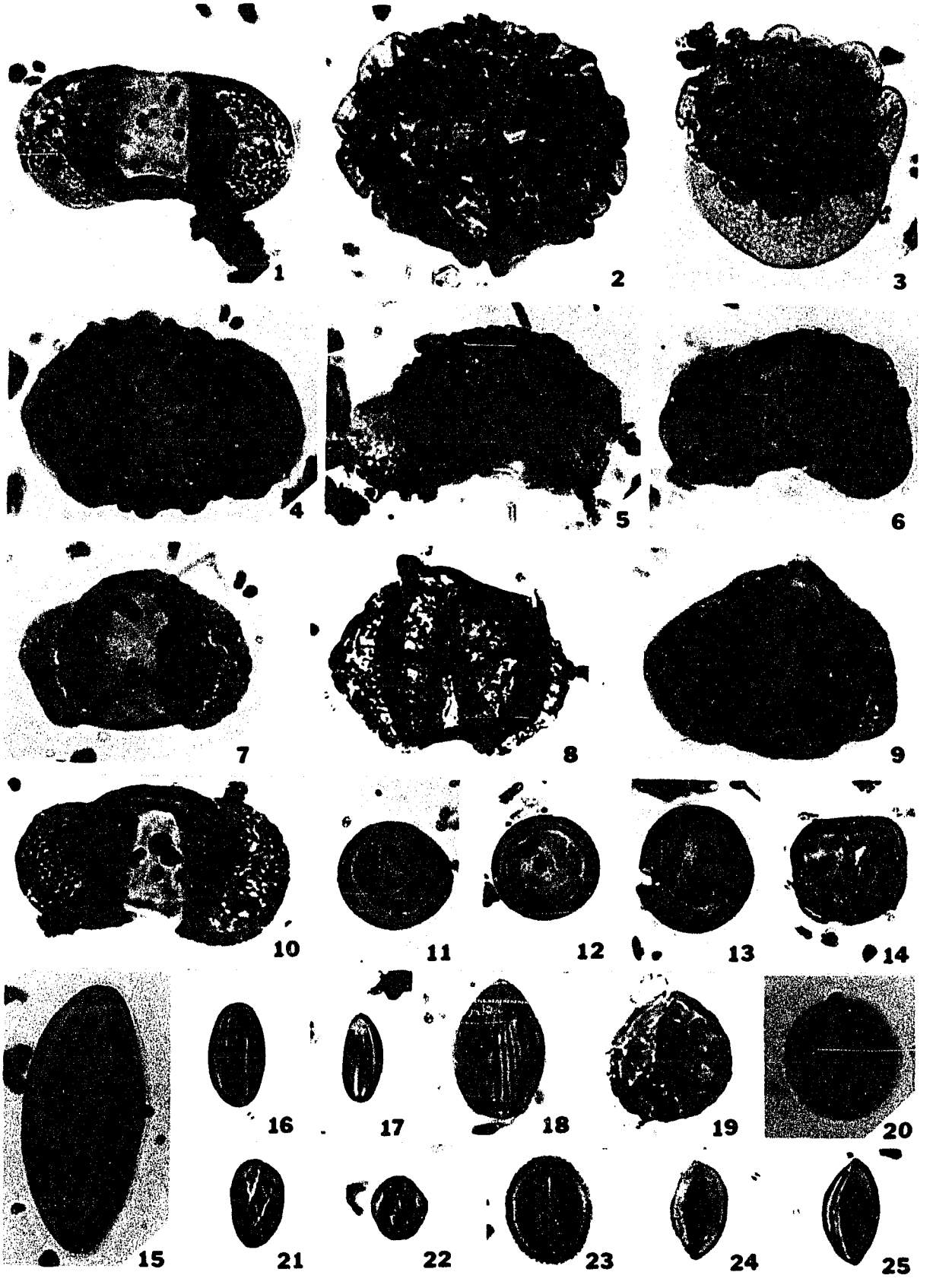
23. Boykin No. 2, 310.5'-314.2'; assemblage no. 6232-2, 31.9 x 105.9; equatorial view.

Figures 24, 25. Cycadopites nitidus (Balme 1957) nov. comb.

24. Webb No. 1, 238.8'-248.0'; assemblage no. 6388-4, 39.7 x 107.3; equatorial view.

25. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 37.5 x 102.8; equatorial view.

PLATE 10



EXPLANATION OF PLATE 11

(all figures magnified 750X unless otherwise specified)

Figures 1-3. Palmaepollenites tranquillus (R. Potonié 1934) R. Potonié 1951.

1. Boykin No. 2, 367.7'-369.0'; assemblage no. 6228-1, 41.5 x 107.2; equatorial view.
2. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 42.9 x 114.8; equatorial view.
3. Cleveland No. 1, 33.0'-34.6'; assemblage no. 6331-4, 29.3 x 105.1; equatorial view.

Figure 4. Palmaepollenites spheroides (Jardiné and Magloire 1965) nov. comb.

4. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-2, 29.0 x 102.6; equatorial view.

Figure 5. Palmaepollenites ?

5. Webb No. 1, 336.0'-338.8'; assemblage no. 6362-2, 47.6 x 107.7; equatorial view, 1000X.

Figures 6, 7. Tricolpopollenites parmularius (R. Potonié 1934) Thomson and Pflug 1953.

6. Webb No. 1, 350.0'-354.0'; assemblage no. 6226-2, 40.3 x 102.3; equatorial view.

7. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-1, 28.3 x 109.2; equatorial view.

Figures 8, 9. Tricolpopollenites retiformis Pflug and Thomson in Thomson and Pflug 1953.

8. Boykin No. 2, 314.2'-320.0'; assemblage no. 6415-4, 39.6 x 105.0; polar view.
9. Boykin No. 2, 249.2'-259.2'; assemblage no. 6279-1, 29.6 x 105.0; polar view.

Figures 10, 11. Tricolpopollenites minutus Brenner 1963.

10. Webb No. 1, 248.0'-261.0'; assemblage no. 6172-3, 42.3 x 114.6; equatorial view.
11. Boykin No. 2, 281.0'-286.6'; assemblage no. 6316-2, 36.4 x 104.9; equatorial view; 1000X.

Figures 12-14. Tricolpopollenites parvulus Groot and Penny 1960.

12. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-4, 38.7 x 102.5; equatorial view.
13. Boykin No. 2, 500.0'-510.5'; assemblage no. 6290-4, 43.8 x 114.8; equatorial view.
14. Boykin No. 2, 345.1'-348.5'; assemblage no. 6402-5, 41.7 x 104.8; equatorial view.

Figure 15. Tricolpopollenites elongatus Groot and Groot 1962.

15. Boykin No. 2, 244.7'-247.7'; assemblage no. 6391-5, 44.7 x 105.2; equatorial view.

Figures 16-18. Retitricolpites cf. R. georgensis Brenner 1963.

16. Boykin No. 2, 310.5'-314.2'; assemblage no. 6371-3, 35.0 x 106.9; polar view.

17. Webb No. 1, 282.0'-289.2'; assemblage no. 6407-3, 33.7 x 111.6; polar view.

18. Boykin No. 2, 459.4'-466.2'; assemblage no. 6365-5, 27.6 x 105.7; oblique polar view.

Figure 19. Retitricolpites virgeus (Groot, Penny and Groot 1961) Brenner 1963.

19. Webb No. 1, 442.3'-445.5'; assemblage no. 6213-4, 40.8 x 119.7; polar view.

Figure 20. Tricolpites microreticulatus Belsky, Boltenhagen and R. Potonié 1965.

20. Webb No. 1, 244.7'-247.7'; assemblage no. 6346-3, 36.3 x 108.6; polar view.

Figures 21, 22. Tricolpites tienabaensis Jardiné and Magloire 1965.

21. Boykin No. 2, 245.4'-246.0'; assemblage no. 6199-3, 39.0 x 109.5; equatorial view.
22. Boykin No. 2, 310.5'-314.2'; assemblage no. 6232-4, 34.1 x 108.2; equatorial view.

Figure 23. Tricolpites wilsonii Kimyai 1966.

23. Boykin No. 2, 310.5'-314.2'; assemblage no. 6371-5, 34.9 x 105.9; equatorial view.

Figures 24, 25. Tricolpites spp.

24. Boykin No. 2, 367.7'-369.0'; assemblage no. 6280-3, 36.7 x 106.5; polar view.
25. Webb No. 1, 228.1'-235.8'; assemblage no. 6388-3, 32.6 x 112.5; polar view.

Figures 26-28. Latipollis normis Krutzsch 1959.

26. Webb No. 1, 369.8'-372.8'; assemblage no. 6286-1, 45.8 x 104.0; equatorial view; focus on aperture.
27. Same specimen as in Figure 26; equatorial focus.
28. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-5, 44.7 x 118.7; equatorial view; focus on aperture.

Figures 29-32. Latipollis latis Krutzsch 1959.

29. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-2, 29.2 x 103.6; oblique polar view.

30. Webb No. 1, 128.8'-135.5'; assemblage no. 6264-1, 32.6 x 112.5; equatorial view.
31. Webb No. 1, 364.0'-366.0'; assemblage no. 6269-3, 29.1 x 111.5; oblique equatorial view.
32. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-2, 47.7 x 109.0; equatorial view.

Figures 33-35. Latipollis verrucosus Groot and Groot 1962.

33. Webb No. 1, 299.6'-311.0'; assemblage no. 6224-4, 43.3 x 107.0; equatorial view.
34. Boykin No. 2, 445.3'-447.6'; assemblage no. 6272-1, 29.3 x 113.5; equatorial view.
35. Boykin No. 2, 459.4'-466.2'; assemblage no. 6365-2, 45.7 x 115.4; equatorial view.

Figure 36. Psilastephanocolpites maia van Hoeken-Klinkenberg 1966.

36. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-4, 30.1 x 104.0; polar view.

Figure 37. Tricolporopollenites sp. 2.

37. Webb No. 1, 435.5'-439.5'; assemblage no. 6297-4, 29.1 x 104.3; equatorial view.

Figure 38. Tricolporopollenites sp. 3.

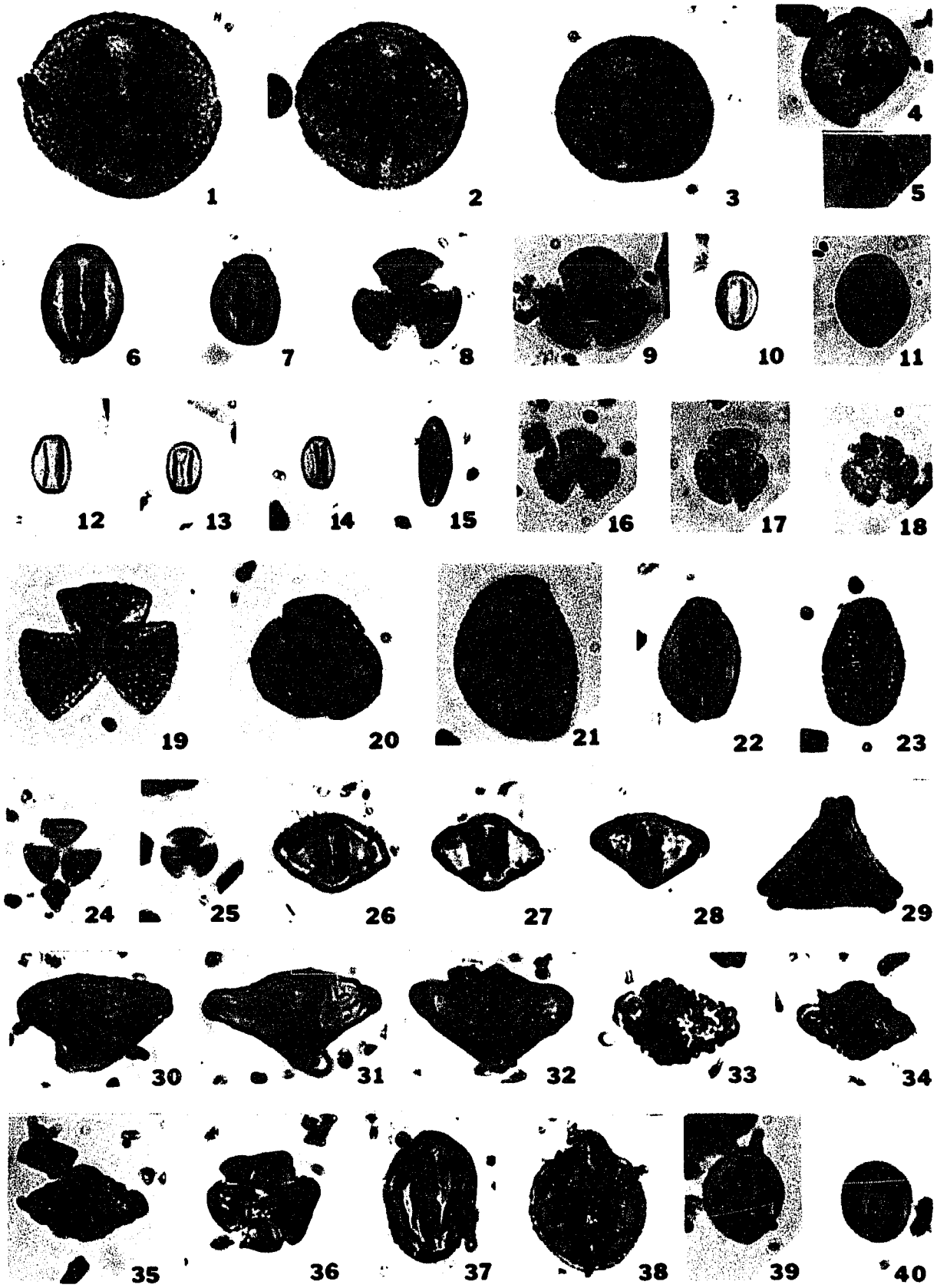
38. Webb No. 1, 277.2'-282.0'; assemblage no. 6251-4, 41.5 x 107.0; oblique equatorial view.

Figures 39-40. Unidentified Tricolporate Sporomorph 1.

39. Boykin No. 2, 320.0'-331.0'; assemblage no. 6271-4, 43.2 x 102.6; equatorial view.

40. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-2, 43.2 x 116.4; equatorial view.

PLATE 11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EXPLANATION OF PLATE 12

(all figures magnified 750X unless otherwise specified)

Figures 1, 2. Tricolporopollenites cf. T. aliquantulus Hedlund 1966.

1. Boykin No. 2, 281.0'-286.6'; assemblage no. 6367-1, 36.0 x 108.2; polar view.
2. Webb No. 1, 267.0'-277.2'; assemblage no. 6346-1, 36.3 x 113.3; polar view.

Figures 3-5. Tricolporopollenites sp. 1.

3. Boykin No. 2, 352.0'-354.0'; assemblage no. 6423-4, 32.1 x 104.6; equatorial view.
4. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-2, 33.6 x 106.6; polar view.
5. Boykin No. 2, 347.0'-348.0'; assemblage no. 6428-5, 26.5 x 109.6; equatorial view; 1000X.

Figures 6, 7. Psilatricolporites prolatus Pierce 1961.

6. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 39.6 x 106.5; equatorial view.
7. Webb No. 1, 128.8'-135.5'; assemblage no. 6166-4, 29.7 x 104.7; equatorial view.

Figures 8, 9. Quercoidites ?

8. Webb No. 1, 292.7'-296.1'; assemblage no. 6324-2, 39.8 x 102.8; equatorial view.

9. Webb No. 1, 277.2'-282.0'; assemblage no. 6251-4, 30.7 x 103.4; equatorial view.

Figure 10. Sporopollis pseudosporites (Pflug in Thomson and Pflug 1953) Pflug 1953.

10. Webb No. 1, 156.2'-167.6'; assemblage no. 6173-1, 32.7 x 114.5; polar view.

Figure 11. Sporopollis sp. 1.

11. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-2, 39.8 x 108.0; polar view.

Figure 12. Sporopollis sp. 2.

12. Webb No. 1, 369.8'-372.8'; assemblage no. 6259-5, 31.0 x 105.6; polar view.

Figures 13, 14. Conclavipollis densilatus Kimyai 1966.

13. Webb No. 1, 369.8'-372.8'; assemblage no. 6286-4, 32.3 x 104.6; polar view.

14. Webb No. 1, 369.8'-372.8'; assemblage no. 6286-1, 37.2 x 104.2; polar view.

Figure 15. Complexiopollis praetumescens Krutzsch 1959.

15. Boykin No. 2, 245.4'-246.0'; assemblage no. 6199-3, 34.1 x 110.3; polar view.

Figure 16. Complexiopollis sp.

16. Webb No. 1, 227.0'-230.0'; assemblage no. 6433-2, 43.4 x 101.7; polar view.

Figure 17. Triorites cf. T. edwardsii Cookson and Pike 1954.

17. Webb No. 1, 227.0'-230.0'; assemblage no. 6422-4, 32.8 x 114.0; polar view.

Figure 18. Andreisporis cf. A. mariae Belsky, Boltenhagen and R. Potonié 1965.

18. Webb No. 1, 282.0'-286.0'; assemblage no. 6407-4, 30.3 x 108.1; proximal polar view.

Figure 19. Unidentified Triporate Sporomorph 2.

19. Boykin No. 2, 477.0'-480.0'; assemblage no. 6359-1, 31.0 x 107.8; polar view.

Figure 20. Unidentified Polyporate Sporomorph 1.

20. Boykin No. 2, 436.7'-444.0'; assemblage no. 6281-1, 27.5 x 114.1; polar view.

Figure 21. Unidentified Triporate Sporomorph 1.

21. Webb No. 1, 364.0'-366.0'; assemblage no. 6334-1, 42.0 x 105.1; polar view.

Figures 22-25. Dicotetradites granulatus Norton in Norton and Hall 1969.

22. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-1, 32.4 x 106.7.
23. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-4, 34.4 x 111.4.
24. Boykin No. 2, 352.0'-354.0'; assemblage no. 6424-1, 32.6 x 109.5.
25. Boykin No. 2, 320.0'-331.8'; assemblage no. 6271-4, 28.6 x 102.7.

Figures 26, 27. Unidentified Dyad Sporomorph 1.

26. Boykin No. 2, 245.4'-246.0'; assemblage no. 6199-3, 31.4 x 115.5.
27. Webb No. 1, 282.0'-286.0'; assemblage no. 6396-4, 46.6 x 112.8.

Figure 28. Unidentified Palynomorph 2.

28. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-2, 44.0 x 120.0'.

Figure 29. Unidentified Palynomorph 1.

29. Webb No. 1, 227.0'-230.0'; assemblage no. 6433-2, 33.0 x 111.5.

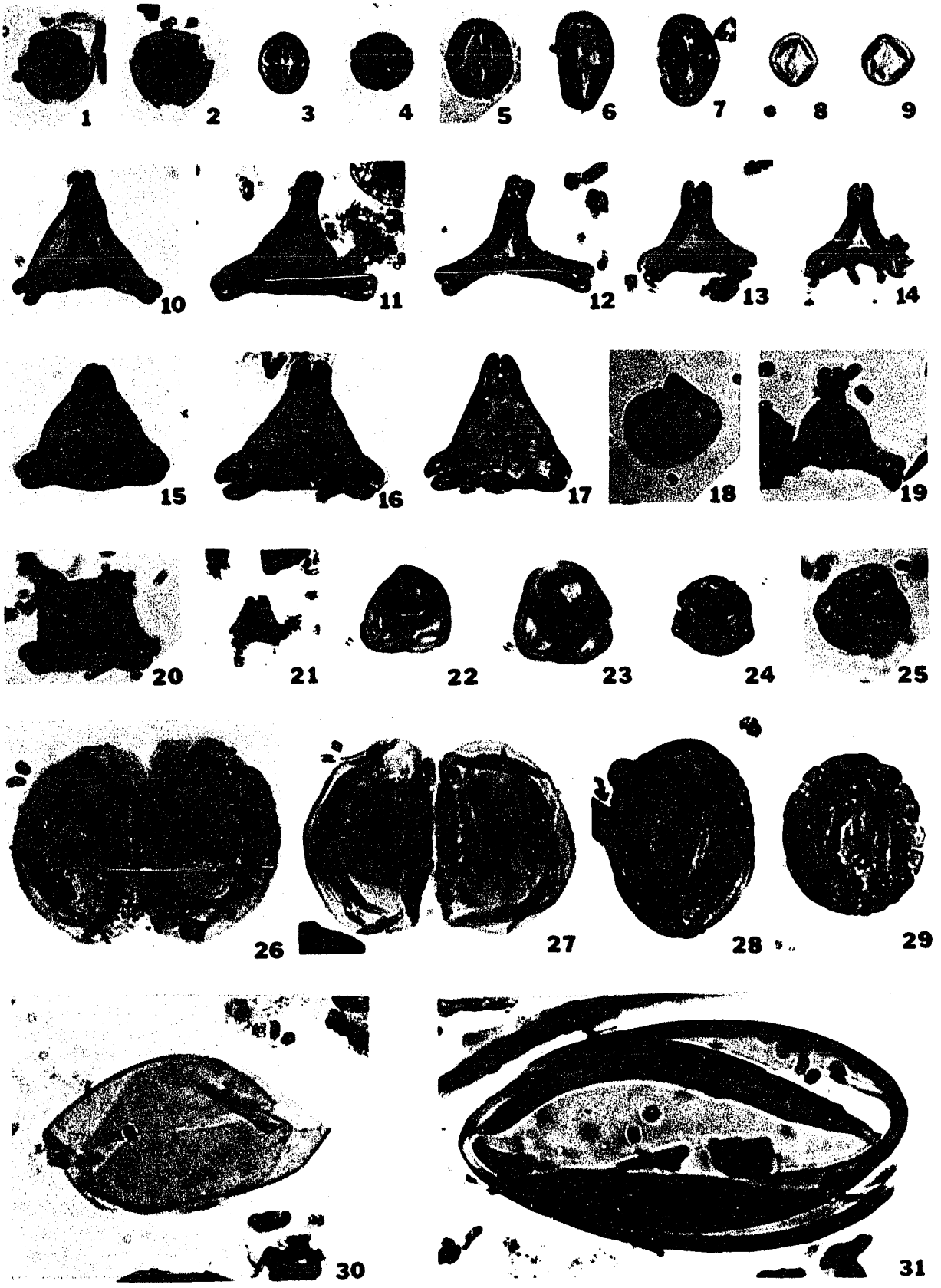
Figure 30. Schizosporis parvus Cookson and Dettmann 1960.

30. Boykin No. 2, 348.0'-350.5'; assemblage no. 6426-4, 36.3 x 109.8.

Figure 31. Schizosporis majusculus Hedlund 1966.

31. Boykin No. 2, 348.0'-350.5'; assemblage no. 6425-3, 34.0 x 103.1.

PLATE 12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EXPLANATION OF PLATE 13

(all figures magnified 750X)

Figure 1. Unidentified Stephanocolpate Sporomorph 1.

1. Boykin No. 2, 369.0'-378.1'; assemblage no. 6230-4, 44.6 x 108.2; polar view.

Figure 2. *Endosporites* ?

2. Webb No. 1, 422.0'-427.0'; assemblage no. 6200-1, 40.4 x 108.7.

Figure 3. *Florinites* sp.

3. Webb No. 1, 506.0'-509.0'; assemblage no. 6170-5, 34.0 x 117.9; polar view.

Figure 4. *Triquitrites* sp.

4. Webb No. 1, 452.7'-454.8'; assemblage no. 6238-1, 37.2 x 115.2; proximal polar view.

Figure 5. *Stellisporites* sp.

5. Webb No. 1, 330.0'-336.0'; assemblage no. 6341-3, 40.2 x 106.4; proximal polar view.

Figure 6. *Hamiapollenites* sp.

6. Webb No. 1, 452.7'-454.8'; assemblage no. 6238-1, 31.2 x 117.1; proximal polar view.

Figure 7. Spinidinium sp.

7. Webb No. 1, 299.6'-311.0'; assemblage no. 6224-4, 40.5 x 120.8; equatorial view; phase contrast lighting.

Figure 8. Unidentified Acritarch 2.

8. Boykin No. 2, 310.5'-314.2'; assemblage no. 6232-2, 41.3 x 115.0; brightfield illumination.

Figures 9, 10. Micrhystridium sp.

9. Webb No. 1, 366.8'-369.8'; assemblage no. 6412-3, 35.5 x 103.4; phase contrast lighting.

10. Boykin No. 2, 367.7'-369.0'; assemblage no. 6228-4, 34.8 x 111.1; phase contrast lighting.

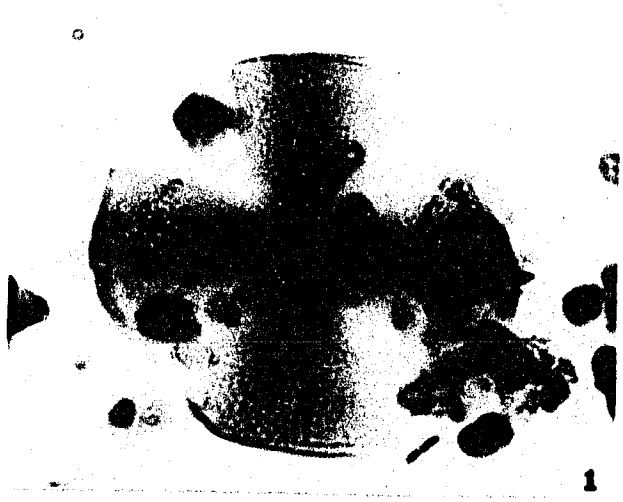
Figure 11. Hystrichosphaeridium truncigerum Deflandre 1937.

11. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 33.9 x 109.2; phase contrast lighting.

Figure 12. Unidentified Acritarch 3.

12. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-1, 36.1 x 102.8; phase contrast lighting.

PLATE 13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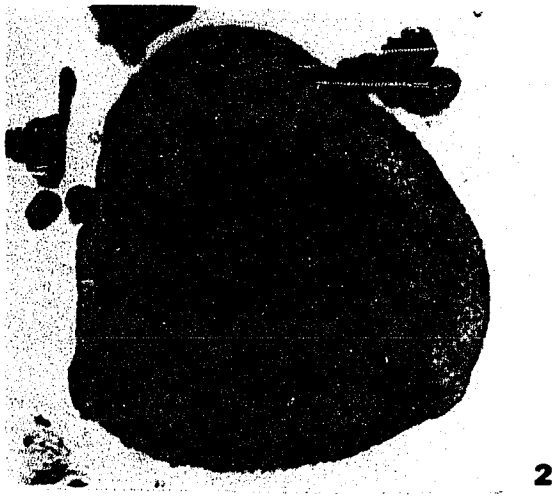
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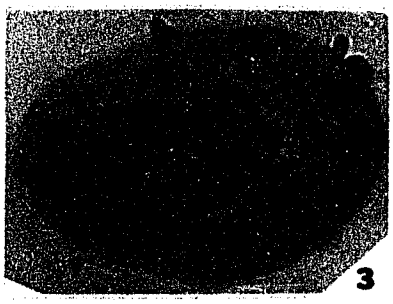
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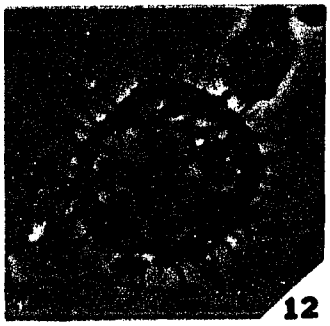
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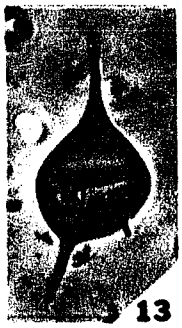
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EXPLANATION OF PLATE 14

(all figures magnified 750X and illuminated by phase contrast lighting)

Figure 1. *Hystrichosphaeridium pulcherrium* Deflandre and Cookson 1955.

1. Webb No. 1, 350.0'-354.0'; assemblage no. 6226-2, 37.0 x 103.8.

Figure 2. *Hystrichosphaeridium tubiferum* (Ehrenberg 1838) Deflandre 1937.

2. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 38.9 x 117.3.

Figure 3. *Baltisphaeridium* sp.

3. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 32.6 x 117.0.

Figure 4. *Hystrichosphaeridium* sp.

4. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-2, 44.2 x 103.3.

Figure 5. *Pterospermopsis* sp.

5. Webb No. 1, 336.0'-338.8'; assemblage no. 6362-3, 35.7 x 114.5; polar view.

Figures 6, 7. Micrhystridium fragile Deflandre 1947.

6. Webb No. 1, 336.0'-338.8'; assemblage no. 6362-3, 42.6 x 119.0.

7. Webb No. 1, 336.0'-338.8'; assemblage no. 6387-2, 47.6 x 107.7.

Figure 8. Unidentified Dinophyceae Cyst 1.

8. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 36.4 x 109.3; equatorial view.

Figure 9. Unidentified Acritarch 1.

9. Webb No. 1, 350.0'-354.0'; assemblage no. 6226-2, 40.4 x 121.0.

Figure 10. Hystrichosphaeridium xanthiopyxides (O. Wetzel 1933) Deflandre 1937.

10. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 46.9 x 110.7.

Figures 11, 12. Micrhystridium piliferum Deflandre 1937.

11. Webb No. 1, 348.0'-261.0'; assemblage no. 6172-3, 44.1 x 110.5.

12. Boykin No. 2, 246.0'-246.4'; assemblage no. 6391-5, 45.2 x 104.9.

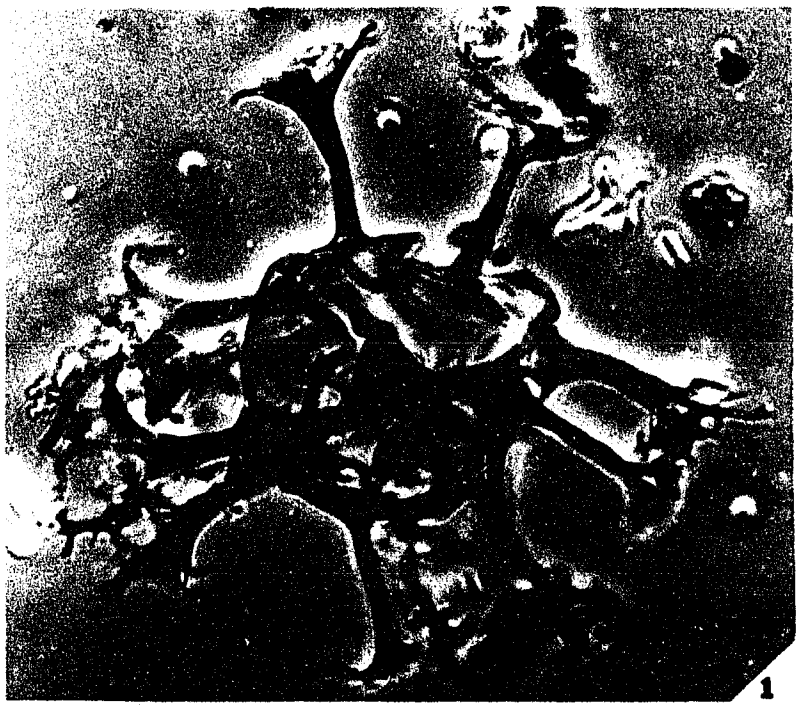
Figure 13. Metaleiofusa diagonalis Wall 1965.

13. Webb No. 1, 248.0'-261.0'; assemblage no. 6172-5, 49.6 x 101.1; equatorial view.

Figure 14. Unidentified Acritarch 3.

14. Boykin No. 2, 307.0'-310.5'; assemblage no. 6165-3, 36.8 x 118.9.

PLATE 14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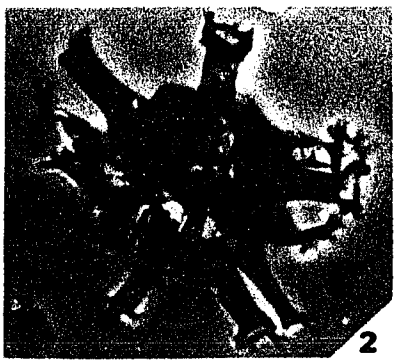
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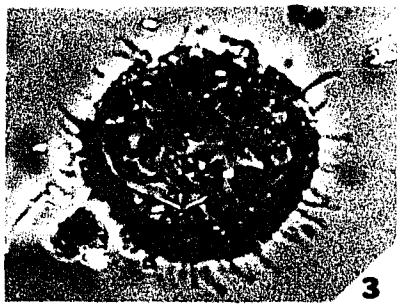
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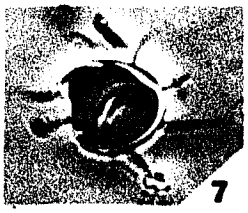
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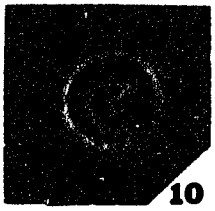
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THE APPLICATION OF STATISTICAL TECHNIQUES TO THE PALYNOFLORAL ANALYSIS OF THE COKER FORMATION (UPPER CRETACEOUS), WESTERN ALABAMA

VOLUME II

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Geology

by
Raymond Anthony Christopher
B.S., University of Rhode Island, 1965
M.S., University of Rhode Island, 1967
May, 1971

APPENDIX A

SYSTEMATICS

The miospore genera recovered during the palynological investigation of the Coker Formation in western Alabama have been organized into a hierarchy which is based on similarities of morphological features rather than on phylogenetic relationships. The hierarchy adopted here is basically that presented by Potonie (1956, 1958, 1960), which was modified by Hart (in manuscript). Hart's modifications were an attempt to make the various categories of the same taxonomic rank reflect differences in the same morphologic features.

The dinophyceae cysts have been organized into the classification presented by Norris and Sarjeant (1965), and genera of the Acritarcha into the morphologic classification presented by Evitt, Downie and Sarjeant (1963).

For each identified species, an abbreviated list of synonyms, a short discussion of its morphologically diagnostic features, and biostratigraphic importance are given, wherever applicable. The list of sysnonyms includes only those references which provided valid descriptions and illustrations of specimens recovered from deposits of Cretaceous Age, or figured significantly in the formation of the species' valid name.

Anteturma SPORITES H. Potonié 1893

Remarks. This group includes those miospores which do not possess pores, sacci or colpi. The aperture is mono-, bi- or trilete, and there may or may not be a zonal structure consisting of a cingulum, zona or non-surrounding thickening. Protuberances of various types may be present.

The Anteturma Sporites has no biostratigraphic significance, as the frequency of occurrence of this group varies with depth and sorting coefficient in Webb No. 1, but varies only with depth in Boykin No. 2.

Turma CHARAGMES Hart (in manuscript)

Remarks. Forms which possess a slit aperture but do not show the development of protuberances, camerae or zonal thickenings or thinnings are included in this turma.

The frequency of occurrence of the Charagmes varies with depth and sorting coefficient in Webb No. 1 and with depth and median grain size in Boykin No. 2. Therefore, the group has no biostratigraphic importance.

Subturma TRILETES (Reinch 1881)
R. Potonié and Kremp 1954

Remarks. Charagmes which possess a trilete aperture are included in this Subturma.

As with the Turma Charagmes, this group displayed variation with changes in depth and sorting coefficient

in Webb No. 1, but with changes in depth and median grain size in Boykin No. 2.

Infraturma LAEVIGATI (Bennie and Kidston 1886)
R. Potonié 1956

Remarks. Triletes which possess a non-muronate, non-apiculate sculpture are included in this infraturma.

The frequency of occurrence of this infraturma varies with changes in depth and sorting coefficient in Webb No. 1, but remains constant throughout the samples examined from the Boykin No. 2.

Genus Calamospora Schopf 1944

1944 Calamospora Schopf, Ill. State Geol. Survey Rept. Invest. 91, pp. 51-52.

Type species: Calamospora hartungiana Schopf 1944.

Calamospora mesozoica Couper 1958
Plate 1, Figures 1, 2

1958 Calamospora mesozoica Couper, Palaeontographica, Abt. B, vol. 103, p. 132, pl. 15, figs. 3, 4.

1969 Calamospora mesozoica Couper. Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 12, pl. 1, fig. 3.

Remarks. Specimens assigned to this species can be differentiated from those assigned to Todisporites minor Couper 1958 by having a greater degree of folding of the

exine.

The nested analysis of variance performed on the frequency of occurrence of this species indicated a highly significant amount of variation was displayed from sample to sample of the same lithologic unit. Thus, the species is unreliable as a biostratigraphic indicator.

Genus Triplanosporites Pflug 1952
emend. Pflug in Thomson and Pflug 1953

1952 Triplanosporites Pflug, Palaönt. Zeit., vol. 26, p. 113.

1953 Triplanosporites Pflug emend. Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 58.

Type species: Triplanosporites sinuosus Pflug 1952.

Triplanosporites sinuosus Pflug 1952
Plate 1, Figures 13-15

1952 Triplanosporites sinuosus Pflug, Palaönt. Zeit., vol. 26, p. 114, fig. 2.

1953 Triplanosporites sinuosus Pflug. Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 58, pl. 3, figs. 5-16.

1953 Triplanosporites sinuosus Pflug. Pflug, Palaeontographica, Abt. B, vol. 95, pl. 15, fig. 39.

1955 Triplanosporites sinuosus Pflug. Delcourt and Sprumont, Mem. Soc. Belge Geologie, N. S. 4, no. 5, p. 45, pl. 2, fig. 7.

1959 Triplanosporites sinuosus Pflug. Krutzsch, Geologie Beih., vol. 8, nos. 21-22, p. 85, pl. 7, figs. 46-51; pl. 8, figs. 52-58.

1962 Triplanosporites sinuosus Pflug. Krutzsch, Atlas, pt. 1, p. 42, pl. 14, figs. 17, 18.

1965 Triplanosporites sinuosus Pflug. Stanley, Bull. Am. Paleont., vol. 46, no. 222, p. 264, pl. 35, figs. 1-5.

1969 Triplanosporites sinuosus Pflug. Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 23, pl. 2, fig. 3.

Remarks. This species is characterized by its thick exine and elongated polar axis. The latter caused most specimens to be oriented in an equatorial plane.

Although the frequency of occurrence of this species indicated variation controlled by changes in depth and sorting coefficient in both cores, the direction of the change with sorting coefficient is in opposite directions for each core.

Genus Cyathidites Couper 1953

1953 Cyathidites Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 27.

Type species: Cyathidites australis Couper 1953.

Remarks. The apices of the species belonging to this genus are more strongly rounded than in the species of Deltoidospora Miner 1935 emend. R. Potonié 1956. Specimens in which the laesurae do not extend to the equator are

assigned to Cyathidites, and those with laesurae extending to the equatorial periphery to Deltoidospora.

The genus has no local biostratigraphic importance. Its frequency of occurrence was controlled by changes in depth and median grain size in Webb No. 1, but only with changes in depth in the Boykin No. 2.

Cyathidites australis Couper 1953

Plate 1, Figures 10-12

1953 Cyathidites australis Couper, New Zealand Geol. Survey Paleont. Bull. 22, p. 27, pl. 2, figs. 11, 12.

1963 Cyathidites australis Couper. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 22, pl. 1, figs. 1-3.

1963 Cyathidites australis Coup. 1953. Singh, Srivastava and Roy, the Palaeobotanist, Lucknow, vol. 12, no. 3, p. 283, pl. 1, figs. 2, 3.

1964 Cyathidites australis Couper 1953. Busnardo and Taugourdeau, Rév. Micropal., vol. 7, no. 3, p. 166, pl. 1, fig. 3.

1965 Cyathidites australis Couper 1953. Döring, Beih. Geol. Zeit., vol. 47, p. 19, pl. 3, figs. 1-3.

1965 Cyathidites australis Couper. van Ameron, Pollen et Spores, vol. 7, no. 1, pp. 101-102, pl. 1, figs. 1a, b; pl. 2, figs. 2a, b; pl. 11, fig. 3.

1966 Cyathidites australis Couper. Burger, Leid. Geol. Meded., vol. 35, p. 237, pl. 5, fig. 2.

1966 Cyathidites australis Couper. van der Hammen and Burger, Leid. Geol. Meded., vol. 38. p. 176, pl. 3, fig. 12.

1966 Cyathidites australis Couper. Helal, Palaeontographica, Abt. B, vol. 117, pp. 88-89, pl. 32, figs. 17, 18.

Remarks. This species displayed no biostratigraphic importance. Its frequency of occurrence was controlled by changes in depth and median grain size in Webb No. 1, and by changes in depth in Boykin No. 2.

Cyathidites minor Couper 1953

Plate 1, Figures 3-6

1953 Cyathidites minor Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 28, pl. 2, fig. 13.

1958 Cyathidites minor Couper. Couper, Palaeontographica, Abt. B, vol. 103, p. 139, pl. 20, figs. 9, 10.

1961 Cyathidites minor Couper 1953. Groot, Penny and Groot, Palaeontographica, Abt. 8, vol. 108, pp. 128-129, pl. 24, fig. 9.

1962 Cyathidites minor Couper. Pocock, Palaeontographica, Abt. B, vol. 111, p. 43, pl. 4, figs. 57, 58.

1963 Cyathidites minor Couper. Brenner, Maryland Dept. Geol., Mines, Water Res., Bull. 27, pp. 53-54, pl. 11, fig. 7.

1963 Cyathidites minor Couper. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, pp. 22-23, pl. 1, figs. 4, 5.

1963 Cyathidites minor Coup. 1953. Singh, Srivastava and Roy, The Palaeobotanist, Lucknow, vol. 12, no. 3, p. 283, pl. 1, figs. 4, 5.

1965 Cyathidites minor Couper. van Ameron, Pollen et Spores, vol. 7, no. 1, p. 102, pl. 1, figs. 2a, b.

1966 Cyathidites minor Couper. Helal, Palaeontographica, Abt. B, vol. 117, p. 89, pl. 32, figs. 19-21.

1966 Cyathidites minor Couper. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 123, pl. 42, fig. 9.

1966 Cyathidites minor Couper 1953. Srivastava, Pollen et Spores, vol. 8, no. 3, pp. 507-508, pl. 1, figs. 8, 16.

1966 Cyathidites minor Couper. van der Hammen and Burger, Leid. Geol. Meded., vol. 38, p. 176, pl. 2, fig. 7.

1969 Cyathidites minor Couper. Agasie, Micropaleontology, vol. 15, no. 1, p. 20, pl. 2, fig. 14.

1969 Cyathidites minor Couper. Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 22, pl. 1, fig. 20.

1969 Cyathidites minor Couper, 1953. Lohrengel, Brigham Young Univ., Geol. Studies, vol. 16, pt. 3, pp. 96-98, pl. 1, fig. 2.

Remarks. The specimens assigned to this species were consistently smaller than those assigned to C. australis.

The frequency of occurrence of C. minor was controlled by changes in both depth and sorting coefficient in the Webb No. 1, but by depth alone in Boykin No. 2. Therefore, this species was of no biostratigraphic importance.

Genus Divisisporites Pflug, in Thomson and Pflug 1953

1953 Divisisporites Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 51.

Type species: Divisisporites divisus Pflug in Thomson and Pflug 1953.

Divisisporites sp.

Plate 1, Figures 7-9

Remarks. This species has been provisionally assigend to the genus Divisisporites pending further taxonomic study. In addition to the bifurcation at the periphery of the laesurae, it has exinal thickenings and thinnings arranged in concentric circles on the distal surface. The thickenings and thinnings are not muri and luminae, as the tectum is continuous.

Although the frequency of occurrence of this species is controlled by depth in the Webb No. 1, its frequency of occurrence remained constant throughout the samples examined from the Boykin No. 2.

Genus Undulatisporites Pflug in Thomson and Pflug 1953

1953 Undulatisporites Pflug in Thomson and Pflug, Paleontographica, Abt. B, vol. 94, p. 52.

Type species: Undulatisporites microcutus Pflug in Thomson and Pflug 1953.

Remarks. The undulating nature of the laesurae is the diagnostic feature of this genus.

This genus is of no biostratigraphic importance.

Undulatisporites undulapolus Brenner 1963

Plate 1, Figure 19

1963 Undulatisporites undulapolus Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 72, pl. 24, fig. 1.

1966 Undulatisporites undulapolus Brenner. van der Hammen and Burger, Leid. Geol. Meded., vol. 38, p. 176, pl. 3, fig. 14.

Remarks. This species does not display variation with changes in depth or grain size in either well.

Undulatisporites sp.

Plate 2, Figure 1

Remarks. Only six grains were found that were assigned to this species, therefore, no conclusive taxonomic comparisons are made.

The species is of no biostratigraphic importance.

Genus Stereisporites Pflug in Thomson and Pflug 1953

1937 Sphagnumsporites Raatz, Abh. Preuss. Geol. L.-A. Berlin, vol. 183, p. 9.

1953 Stereisporites Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 53.

1953 Sphagnites Cookson, Austr. Jour. Bot., vol. 1, no. 3, p. 463.

Type species: Stereisporites stereoides (R. Potonié and Venitz 1934) Pflug 1953.

Remarks. The author has followed the designation provided by Dettmann (1963) concerning the taxonomy of this genus. Dettmann (1963) considered Stereisporites the valid generic name because Sphagnumsporites Raatz 1937 was a nomen nudum. Sphagnites Cookson 1953 is a junior synonym.

Stereisporites antiquasporites (Wilson and Webster 1946) Dettmann 1963

Plate 1, Figures 17, 18

1946 Sphagnum antiquasporites Wilson and Webster, Amer. Jour. Bot., vo. 33, p. 273, fig. 2.

1954 Sphagnum antiquasporites Wilson and Webster. Radforth and Rouse, Can. Jour. Bot., vol. 32, pp. 190-191, pl. 1, fig. 1.

1956 Sphagnumsporites antiquasporites (Wilson and Webster 1946) R. Potonié, Beih. Geol. Jb., vol. 23, p. 17.

1957 Sphagnum antiquasporites Wilson and Webster. Rouse, Can. Jour. Bot., vol. 35, pp. 353-354, pl. 1, figs. 32, 33; pl. 2, figs. 40, 41.

1962 Sphagnumsporites antiquasporites (Wilson & Webster) Pocock, Palaeontographica, Abt. B, vol. 111, p. 32, pl. 1, figs. 1-3.

1963 Sphagnumsporites antiquasporites (Wilson and Webster) Potonié. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 41-42, pl. 4, figs. 1a, b.

1963 Stereisporites antiquasporites (Wilson and Webster) Dettmann, Roy. Soc. Victoria Proc. New Ser. vol. 77, pt. 1, p. 25, pl. 1, figs. 20, 21.

1965 Sphagnum antiquasporites Wilson and Webster. Stanley, Bull. Amer. Paleont., vol. 49, no. 222, pp. 236-237, pl. 27, figs. 1-5.

1966 Sphagnumsporites antiquasporites (Wilson & Webster) R. Potonié. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 120, pl. 42, fig. 1.

1966 Stereisporites antiquasporites (Wilson and Webster) Dettmann. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 501, pl. 1, figs. 1-3.

1967 Stereisporites antiquasporites (Wilson and Webster) Dettmann. Drugg, Palaeontographica, Abt. B, vol. 120, p. 37, pl. 6, fig. 19.

Remarks. This species does not display variation in either cores. Therefore, it is of no biostratigraphic importance.

Genus Leiotriletes Naumova 1937 ex R. Potonié and Kremp 1954

1937 Leiotriletes Naumova, Rept. 17th Int. Geol. Congress, vol. 1, p. 355.

1954 Leiotriletes Naumova ex R. Potonié and Kremp, Geol. Jb., vol. 69, p. 120.

Type species: Leiotriletes sphaerotriangulus (Loose in R. Potonié, Ibrahim and Loose 1932) R. Potonié and Kremp 1954.

Leiotriletes paramaximus Krutzsch 1959

Plate 1, Figure 16

1959 Leiotriletes paramaximus Krutzsch, Geol. Beih., vol. 8, nos. 21-22, pp. 62-63, pl. 4, figs. 20, 21.

1966 Matonisporites impensus Hedlund, Okla. Geol. Survey, Bull. 112, p. 13, pl. 2, figs. 1a, b.

1969 Matonisporites impensus Hedlund. Agasie, Micropaleontology, vol. 15, no. 1, p. 22, pl. 3, fig. 1.

Remarks. The species described by Hedlund (1966) is identical to that described by Krutzsch.

The species is of no biostratigraphic importance as its frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1, and by changes in depth and median grain size in Boykin No. 2.

Genus Deltoidospora Miner 1935 emend. R. Potonié 1956

1935 Deltoidospora Miner, Amer. Medl. Nat., vol. 16, p. 618.

1956 Deltoidospora (Miner 1935) emend. R. Potonié, Beih, Geol. Jb., vol. 23, p. 13.

Type species: Deltoidospora hallii Miner 1935.

Remarks. See the genus Cyathidites. The frequency of occurrence of this genus is controlled by changes in depth and sorting coefficient in both cores, i.e., the distribution of this genus is controlled by lithologic changes as well as changes in time. Its relevance as an environmental indicator should be further investigated.

Deltoidospora hallii Miner 1935

Plate 2, Figures 2, 3

1935 Deltoidospora Hallii Miner, Amer. Midl. Nat., vol. 16, p. 618, pl. 24, figs. 7, 8.

1962 Deltoidospora hallii Miner. Pocock, Palaeontographica, Abt. B, vol. 111, p. 48, pl. 5, fig. 81.

1963 Deltoidospora hallii Miner. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 61, pl. 15, fig. 5.

Remarks. The apices of Deltoidospora hallii Miner 1935 are more angular than those of Cyathidites minor Couper 1953 and the laesurae usually longer than in C. minor.

This species may have environmental significance, as its frequency of occurrence is controlled by changes in depth and sorting coefficient in both core holes examined.

Deltoidospora juncta (Kara-Murza 1961) Singh 1964

Plate 2, Figure 8

1961 Leiotriletes juncta Kara-Murza, Vnigri (Trudy All Union Petrol. Sci. Res. Geol. Exped. Inst.), vol. 177, p. 357.

1964 Deltoidospora juncta (Kara-Murza 1961) Singh, Res. Council of Alberta Bull., vol. 15, p. 79, pl. 2, figs. 5, 6.

Remarks. This species is readily differentiated from Gleicheniidites apilobatus Brenner 1963 by its lack of exinal thickening in the interarea.

Although the frequency of occurrence of the species is related to depth in Boykin No. 2, it remains constant throughout Webb No. 1.

Genus Todisporites Couper 1958

1958 Todisporites Couper, Palaeontographica, Abt. B, vol. 103, p. 134.

Type species: Todisporites major Couper 1958.

Remarks. Couper's (1958) original description of the genus included the remarks that the genus is characterized by a thin, slightly folded exine.

The frequency of occurrence of this genus displayed a highly significant amount of variation from sample to sample taken from the same lithologic unit. Therefore, correlations based on changes in the frequency of occurrence of Todisporites would be tenuous.

Todisporites minor Couper 1958

Plate 2, Figures 4-7

1958 Todisporites minor Couper, Palaeontographica, Abt. B, vol. 103, p. 135, pl. 16, figs. 9, 10.

1962 Todisporites minor Couper. Pocock, Palaeontographica, Abt. B, vol. 111, p. 36, pl. 1, fig. 16.

1963 Todisporites minor Couper. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 45, pl. 10, fig. 9.

1966 Todisporites minor Couper. Helal, Palaeontographica, Abt. B, vol. 117, p. 87, pl. 31, figs. 6, 7.

1966 Todisporites minor Couper. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 121, pl. 42, fig. 3..

1966 Todisporites minor Couper 1958. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 504, pl. 1, fig. 10.

Remarks. In addition to displaying a highly significant amount of variation from sample to sample of the same lithologic unit, the frequency of occurrence of this species varies with changes in depth and sorting coefficient in Webb No. 1, but only with changes in depth in Boykin No. 2. Thus, it was not used in the biostratigraphic analyses.

Todisporites scabratus Groot and Groot 1962

Plate 2, Figure 10

1962 Todisporites scabratus Groot and Groot, Communications of the.Geol. Survey of Portugal, vol. 46, p. 144, pl. 1, fig. 2.

Remarks. The scabrate nature of the exine and generally larger size allow differentiation of this species from Todisporites minor Couper 1958.

Although the frequency of occurrence of this species displayed a highly significant amount of variation from sample to sample in the same lithologic unit, the frequency of occurrence was controlled by changes in depth in both cores. For the latter reason it was used in establishing the biostratigraphic florizones. The range of the species in both cores shows that it first appeared in Zone A, reached its minimum frequency of occurrence in Zone B, and last occurred in Zone C.

Genus Dictyophyllidites Couper 1958 emend. Dettmann 1963

1958 Dictyophyllidites Couper, Palaeontographica, Abt. B, vol. 103, p. 140.

1963 Dictyophyllidites Couper emend. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 27.

Type species: Dictyophyllidites harrisii Couper 1958.

Dictyophyllidites cf. D. harrisii Couper 1958

Plate 2, Figure 11

1958 Dictyophyllidites harrisii Couper, Palaeontographica, Abt. B, vol. 103, p. 140, pl. 21, figs. 5, 6.

Remarks. As no specimens of this species were recovered from Boykin No. 2, the species has no biostratigraphic importance.

Genus Plicifera Bolkhovitina 1967

1967 Plicifera Bolkhovitina, Rev. Palaeobotan. Palynol., vol. 3, pp. 62-63.

Type species: Plicifera delicata (Bolkhovitina 1953) Bolkhovitina 1967.

Plicifera delicata (Bolkhovitina 1953) Bolkhovitina 1967

Plate 2, Figure 9

1953 Gleichinia delicata Bolkhovitina, Trudy Inst. Geol. Nauk, Akad. Sci. S.S.S.R., Rel. 145, Geol. Ser. no. 61, p. 22, pl. II, figs. 1-4.

1967 Plicifera delicata (Bolkhovitina) Bolkhovitina, Rev. Palaeobotan. Palynol., vol. 3, pp. 62-63, pl. I, fig. a.

Remarks. Bolkhovitina (1967) separated Gleicheniidites into four morphological groups and assigned valid generic names to each. Plicifera was defined to include trilete laevigate miospores with distal, interareal folds in the exine. The groups created by Bolkhovitina are in apparent agreement with the re-evaluation of the species Gleicheniidites senonicus Ross 1949 ex Delcourt and Sprumont 1955 made by Skarby (1964) who emended the species to include only those forms which were trilete, laevigate, and possess equatorial exinal thickenings in the interarea.

The frequency of occurrence of the species varied significantly from sample to sample of the same lithologic

unit, and is of little or no biostratigraphic value.

Unidentified Laevigate Sporomorph 1

Plate 2, Figure 16

Remarks. Only one specimen was recorded. Taxonomic or biostratigraphic remarks are pointless.

Unidentified Laevigate Sporomorph 2

Plate 2, Figure 20

Remarks. Small size and a persistent orientation in which the laesurae are obscured probably make this a heterogeneous morphological group.

The frequency of occurrence of the species varied with depth and sorting coefficient in Webb No. 1, but only with depth in Boykin No. 2.

Infraturma APICULATI (Bennie and Kidston 1886)

R. Potonié 1956

Remarks. This infraturma includes Triletes possessing apiculate sculpture.

Although Apiculati displayed variation in its frequency of occurrence with depth in both cores, the response surface differed from core to core. Therefore, correlations based on changes in the frequency of occurrence of Apiculati cannot be made. As the local range of this Infraturma extends throughout all palynomorph-yielding samples, its use as a biostratigraphic indicator is limited.

Genus Trilites Cookson 1947 ex Couper 1953

1947 Trilites Cookson, B.A.N.Z. Antarct. Res. Exped. (1929-1931), Rept. Ser. A, vol. 2, p. 136.

1953 Trilites Cookson ex Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 29.

Type species: Trilites tuberculiformis Cookson 1947.

Trilites sp.

Plate 2, Figures 12-15

Remarks. This species is similar to Trilites sp. Hedlund 1966, from the Cenomanian Woodbine Formation of Oklahoma.

The relative frequency of occurrence of this species is controlled by changes in depth and sorting coefficient in Webb No. 1, and by depth alone in Boykin No. 2. The species has no biostratigraphic importance.

Genus Acanthotriletes Naumova 1937
ex R. Potonié and Kremp 1954

1937 Acanthotriletes Naumova, Rept. 17th Int. Geol. Congress, vol. 1, p. 60.

1954 Acanthotriletes (Naumova 1937) R. Potonié and Kremp, Geol. Jb., vol. 69, p. 83.

Type species: Acanthotriletes ciliatus (Knox 1949) R. Potonié and Kremp 1954.

Remarks. The frequency of occurrence of this genus varied with changes in depth in both the Webb and Boykin

core holes. It ranged throughout all palynomorph-yielding samples.

Acanthotriletes levidensis Balme 1957

Plate 2, Figure 17

1957 Acanthotriletes levidensis Balme, Austr. Comm. Sci. Ind. Res. Org., Coal Res. Sect., Ref. T. C. 25, p. 18, pl. 1, figs. 18, 19.

1966 Acanthotriletes levidensis Balme. Muller, Micropaleontology, vol. 14, no. 1, p. 6, pl. 1, fig. 4.

Remarks. Only five specimens temporarily assigned to Acanthotriletes levidensis Balme 1957 were recorded.

The frequency of occurrence was controlled by depth in the Webb No. 1, but remained constant throughout the Boykin No. 2. Thus, the species is of little biostratigraphic value.

Acanthotriletes varispinosus Pocock 1962

Plate 2, Figures 18, 19

1962 Acanthotriletes varispinosus Pocock, Palaeontographica, Abt. B, vol. 111, p. 36, pl. 1, figs. 18-20.

1966 Acanthotriletes varispinosus Pocock 1962. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 502, pl. 3, fig. 7.

Remarks. The spines are highly variable in length, basal diameter, and number which originate from one base. The specimens included in the species are almost always spherical, with indistinct laesurae.

The species is of no biostratigraphic importance as its frequency of occurrence was controlled by depth in Webb No. 1, but by sorting coefficient in Boykin No. 2.

Acanthotriletes sp. 1

Plate 2, Figures 21, 22

Remarks. Frequency of occurrence was controlled by changes in median grain size in Boykin No. 2, but remained constant in Webb No. 1, and the sporomorph group was not used in biostratigraphic correlations.

Acanthotriletes sp. 2

Plate 2, Figures 23, 24

Remarks. This group can be distinguished from Acanthotriletes sp. 1 by the consistently narrower base of its spines, and its somewhat smaller size.

The sporomorph group displayed a highly significant amount of variation from sample to sample of the same lithologic unit, and correlations based on changes in its frequency of occurrence are unreliable. Its frequency of occurrence was controlled by depth and median grain size in Webb No. 1, but remained constant throughout the samples examined from Boykin No. 2.

Genus Ornamentifera Bolkhovitina 1967

1967 Ornamentifera Bolkhovitina, Rev. Palaeobotan., Palynol., vol. 3, p. 63-64.

Type species: Ornamentifera echinata (Bolkhovitina 1953) Bolkhovitina 1967.

Ornamentifera confossa (Hedlund 1966) nov. comb.

Plate 3, Figures 1, 2

1966 Gleicheniidites confossus Hedlund, Okla. Geol. Survey Bull. 112, p. 17, pl. 1, figs. 8a-c.

Remarks. The genus Ornamentifera was established by Bolkhovitina (1967) to accommodate trilete miospores which possess exinal folds on the distal surface in the interareas, and an apiculate sculpture.

The species O. confossa is restricted to lignites and is fairly abundant in the lignite located at 348.0'-350.5' in Boykin No. 2. No specimens were recorded from any of the samples used to evaluate the effects of depth and/or grain size parameters on the frequency of occurrence of miospores.

Unidentified Apiculate Sporomorph 1

Plate 3, Figures 3-5

Remarks. This species can be identified by the elongated ridges perpendicular to the laesurae which extend 1 to 2 microns on either side of the commissure. The remainder of the proximal and distal surface is sculptured with grana 0.5 to almost 1 micron in diameter.

This species was recorded only from Webb No. 1, where its frequency of occurrence was controlled by changes in

depth. As its geographic dispersion is limited, its use in palynofloral zonation is limited.

Unidentified Apiculate Sporomorph 2

Plate 3, Figure 6

Remarks. This species resembles Unidentified Apiculate Sporomorph 1, with the exception that the ridges perpendicular to the commissures are absent. The taxon is characterized by a spherical shape and grana coarser at the center of the contact areas than at the apical areas.

The frequency of occurrence was controlled only by depth in both core holes. Thus, the species provided useful biostratigraphic information. The prediction equations which characterize the distribution of the species in each core does not include the same terms, and correlations based on changes in the frequency of occurrence of the species cannot be made. However, the species first appears in Florizone A, where it reaches its maximum abundance. In Florizone B, its minimum abundance was recorded in both wells. This species last occurred in Florizone C of Boykin No. 2, but extended beyond the limits of that zone in Webb No. 1. The biostratigraphic importance of the species lies in its first appearance in Zone C.

Unidentified Apiculate Sporomorph 3

Plate 3, Figure 7

Remarks. One specimen was assigned to this species. The large verrucae which sculpture the exine, and the raised laesurae are distinctive features, not found on any other species observed.

Infraturma MURONATI R. Potonié and Kremp 1954

Remarks. The Muronati include Triletes with a muronate sculpture.

The Infraturma varied with changes in depth and sorting coefficient in Webb No. 1 and changes in depth and median grain size in Boykin No. 2. It is of no biostratigraphic importance.

Genus Cicatricosisporites R. Potonié and Gelletich 1933

1933 Cicatricosisporites R. Potonié and Gelletich, Sitz. Ber. Ges. Naturf. Freunde, Berlin, p. 522.

1950 Mohriadites Thiergart, Geol. Jb., vol. 65, p. 84.

1951 Mohriosporites R. Potonié, Palaeontographica, Abt. B, vol. 91, p. 135.

1953 Mohriosporites Cookson, Austr. Jour. Bot., vol. 1, no. 3, p. 470.

Type species: Cicatricosisporites dorogensis R. Potonié Gelletich 1933.

Remarks. Although this genus encompasses a wide variety of morphological forms, its frequency of occurrence

is controlled by the quadratic effect of depth and by changes in median grain size in both wells, indicating that it may be environmentally controlled.

Cicatricosisporites dorogensis R. Potonié and Gelletich 1933

Plate 3, Figures 8-10

1933 Cicatricosisporites dorogensis R. Potonié and Gelletich, Sitz. Ber. Ges. Naturf. Freunde, Berlin, p. 522, pl. 1, figs. 1-5.

1951 Mohriosporites dorogensis (Potonié and Gelletich) Potonie, Palaeontographica, Abt. B, vol. 91, pl. 20, fig. 14.

1953 Cicatricosisporites dorogensis R. Pot. Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, pp. 48-49, pl. 1, figs. 1-6, 8, 10-12.

1957 Cicatricosi-sporites dorogensis Potonié and Gelletich. Rouse, Can. Jour. Bot., vol. 35, p. 362, pl. 2, figs. 38, 39.

1958 Cicatricosisporites dorogensis R. Potonié and Gelletich. Couper, Palaeontographica, Abt. B, vol. 103, p. 136, pl. 17, figs. 10-12.

1961 Cicatricosisporites dorogensis R. Potonié and Gelletich 1933. Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 128, pl. 24, fig. 8.

1962 Cicatricosisporites dorogensis R. Potonié and Gelletich. Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, p. 145, pl. 1, fig. 4.

1962 Cicatricosisporites dorogensis R. Potonié & Gelletich. Pocock, Palaeontographica, Abt. B, vol. 111, p. 39, pl. 2, figs. 35, 35; pl. 3, figs. 37-41.

1964 Cicatricosisporites dorogensis Pot. & Gell. Pocock, Grana Palynologica, vol. 15, pp. 159-160, pl. 2, fig. 19.

1964 Cicatricosisporites dorogensis Potonié and Gelletich. Singh, Res. Council Alberta Bull. 15, p. 57, pl. 6, fig. 1.

1967 Cicatricosisporites dorogensis Potonié & Gelletich. Drugg, Palaeontographica, Abt. B, vol. 120, p. 39, pl. 6, fig. 30.

1969 Cicatricosisporites dorogensis Potonié and Gelletich. Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 16, pl. 1, fig. 11.

1969 Cicatricosisporites dorogensis Potonié and Gelletich 1933. Lohrengel, Brigham Young Univ. Geol. Studies vol. 16, pp. 99-100, pl. 1, figs. 3, 4.

Remarks. The frequency of occurrence of this species was controlled by changes in depth and grain size in both wells. In Webb No. 1, changes in sorting coefficient, and in Boykin No. 2, changes in median grain size partially controlled the frequency of occurrence.

Cicatricosisporites australiensis (Cookson 1953) R. Potonié 1956

Plate 3, Figures 11, 12

1953 Mohrioisporites australiensis Cookson, Austr. Jour. Bot., vol. 1, no. 3, p. 470, pl. 2, figs. 31-34.

1956 Cicatricosisporites australiensis (Cookson) R. Potonié, Beih. Geol. Jb., vol. 23, p. 48.

1963 Cicatricosisporites australiensis (Cookson) Potonié. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 48, pl. 8, figs. 1-3.

Remarks. This species can be distinguished from C. dorogensis R. Potonié and Gelletich 1933 by the slight exinal thickenings in the area where the muri coalesce at the apices, by the slightly larger size, and by the narrower muri.

The frequency of occurrence of this species remained constant throughout its range in both wells, and was not used in establishing biostratigraphic zones.

Cicatricosisporites carlylensis Pocock 1962

Plate 3, Figures 13, 14

1962 Cicatricosisporites carlylensis Pocock, Palaeontographica, Abt. B, vol. 111, p. 40, pl. 2, figs. 33, 34.

1969 Cicatricosisporites carlylensis Pocock. Norton and Hall, Paleontographica, Abt. B, vol. 125, p. 17, pl. 1, fig. 12.

Remarks. The relatively thick muri which parallel the equator and extend beyond the periphery of the grain at the apices characterize this species.

Frequency of occurrence of this species was controlled by changes in depth in both cores examined. Its usefulness in recognizing biostratigraphic florizones is because its last occurrence is recorded from samples within Florizone C in both cores. The frequency of occurrence of this species increased downward in Boykin No. 2, but in Webb No. 1 its minimum abundance is recorded from Zone B, and it increased in both Florizones A and C.

Cicatricosisporites aralica (Bolkhovitina 1961) Brenner 1963

Plate 3, Figure 15

1961 Ruffordia aralica Bolkhovitina, Trudy Inst. Geol. Akad. Sci., S.S.S.R, no. 40, p. 13, pl. 1, figs. 9f-h.

1963 Cicatricosisporites aralica (Bolkhovitina) Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 47-48, pl. 7, figs. 4, 5.

Remarks. Specimens were recovered from too few samples to subject the species to statistical analysis. Thus, it was not used in biostratigraphic correlation.

Cicatricosisporites venustus Deák 1963

Plate 3, Figures 16-18

1963 Cicatricosisporites venustus Deák, Rév. Micropal., vol. 5, no. 4, pp. 252-254, pl. 2, figs. 8, 9, 12, 13.

1965 Cicatricosisporites venustus Deák. Deák, Geologica Hungarica, Ser. Paleont., vol. 29, p. 25, pl. 3,

figs. 1-5.

Remarks. It is possible that many specimens described by various authors as Cicatricosisporites hallei Delcourt and Sprumont 1955 belong to C. venustus Deák 1963. The difference between the two species lies in the morphology of the muri. C. hallei possesses muri which are flat-topped whereas C. venustus possess muri which are rounded. In both species, the muri are not parallel to the equator.

Frequency of occurrence is controlled by changes in depth in Webb No. 1, but by changes in median grain size in Boykin No. 2, thus the species was not used to establish florizones.

Cicatricosisporites lucifer Hughes and Moody-Stuart 1967

Plate 3, Figures 19, 20

1967 Cicatricosisporites lucifer Hughes and Moody-Stuart, Rev. Palaeobotan. Palynol., vol. 3, pp. 349-352, pl. I, figs. A-E, H-K, text-fig. 1.

Remarks. This species is recognized by three or four widely spaced proximal muri extending beyond the periphery at the apices, and joining at the distal pole to form a circular sculptural element.

The frequency of occurrence of this species remained constant throughout the samples examined, therefore, it was not used in correlating the two cores.

Cicatricosisporites coconinoensis Agasie 1969

Plate 4, Figures 1-3

1969 Cicatricosisporites coconinoensis Agasie, Micropaleontology, vol. 15, no. 1, p. 18, pl. 1, figs. 9-10.

Remarks. Frequency of occurrence of this species was controlled by changes in depth and sorting coefficient in Webb No. 1, but remained constant throughout Boykin No. 2. Thus it was not used when the florizones were established.

Cicatricosisporites sp.

Plate 4, Figure 5

Remarks. The cicatricose sculpturing of this species is present only on the distal hemisphere, where three to four muri parallel the equator. Simple laesurae extend to the equator.

No specimens assigned to this species were recovered within the data collected for this investigation.

Genus Lygodioisporites R. Potonié 1951

1951 Lygodioisporites R. Potonié, Palaeontographica, Abt. B, vol. 91, p. 133.

Type species: Lygodioisporites solidus R. Potonié 1951.

Lygodioisporites cf. L. perverrucatus Couper 1958

Plate 4, Figures 6, 7

1958 Lygodioisporites perverrucatus Couper,

Palaeontographica, Abt. B, vol. 103, p. 144, pl. 23, figs. 4, 5.

Remarks. Not enough specimens of good preservation were recovered to allow definite identification.

No specimens were recovered from Boykin No. 2, and no biostratigraphically important information is attributed to this species.

Genus Chomotriletes Naumova 1937 ex Naumova 1953

1937 Chomotriletes Naumova, Rept. 17th Int. Geol. Congress, vol. 1, p. 60.

1953 Chomotriletes Naumova 1937. Naumova, Trudy Inst. Geol. Nauk, Acad. Sci. S.S.S.R., Rel. 143 Geol. Ser. no. 60, p. 58.

Type species: Chomotriletes vedugensis Naumova 1953.

Chomotriletes fragilis Pocock 1962

Plate 4, Figures 8-10

1962 Chomotriletes fragilis Pocock, Palaeontographica, Abt. B, vol. 111, p. 39, pl. 3, figs. 30-32.

1964 Chomotriletes fragilis Pocock. Pocock, Grana Palynologica, vol. 5, pp. 175-176, pl. 4, fig. 21.

Remarks. This species is absent in Webb No. 1, and its frequency of occurrence remained constant throughout its range in Boykin No. 2. A significant amount of variation was detected from sample to sample of the same lithologic unit, and it was not used for biostratigraphy.

Genus Rugulatisporites Pflug and Thomson in Thomson and Pflug 1953

1953 Rugulatisporites Pflug and Thomson in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 56.

Type species: Rugulatisporites quintus Pflug and Thomson, in Thomson and Pflug 1953.

Rugulatisporites caperatus van Hoeken-Klinkenberg 1964

Plate 4, Figures 11, 12

1964 Rugulatisporites caperatus van Hoeken-Klinkenberg, Pollen et Spores, vol. 6, no. 1, pp. 229-230, pl. 7, fig. 20.

Remarks. Frequency of occurrence remained constant throughout the samples examined from Boykin No. 2, but was controlled by changes in depth and sorting coefficient in Webb No. 1. The species was not considered biostratigraphically important.

Genus Microreticulatisporites Knox 1950 ex R. Potonié and Kremp 1955

1950 Microreticulatisporites Knox, Trans. Proc. Bot. Sco. Edin., vol. 35, p. 319.

1955 Microreticulatisporites Knox ex R. Potonié and Kremp, Palaeontographica, Abt. B, vol. 98, p. 96.

Type species: Microreticulatisporites lacunosus (Ibrahim 1933) Knox 1950.

Microreticulatisporites pseudofoveolatus Deák 1964

Plate 4, Figures 13, 14

1964 Microreticulatisporites pseudofoveolatus Deák, Acta Botanica, vol. 10, p. 94, pl. 2, figs. 16-18.

1965 Microreticulatisporites pseudofoveolatus Deák. Deák, Geologica Hungarica, ser. Paleont., vol. 29, p. 24, pl. 3, figs. 8-10.

Remarks. This species was not recorded from Boykin No. 2. Its frequency of occurrence was controlled by changes in depth and sorting coefficient in the Webb No. 1.

Genus Foveotriletes van der Hammen 1954 ex R. Potonié 1956

1954 Foveotriletes van der Hammen, Bol. Geol., Bogata, vol. 2, pt. 1, p. 14.

1956 Foveotriletes (van der Hammen 1954, S. 14) ex R. Potonié, Beih. Geol. Jb., vol. 23, p. 43.

Type species: Foveotriletes scrobiculatus (Ross 1949) R. Potonié 1956.

Remarks. Frequency of occurrence of the genus was controlled by changes in depth and median grain size in Webb No. 1, but remained constant throughout the samples examined from the Boykin No. 2. It was not considered biostratigraphically important.

Foveotriletes parviretus (Balme 1957) Dettmann 1963

Plate 4, Figures 15, 16

1957 Microreticulatisporites parviretus Balme, Austr.

Commonwealth Sci. Ind. Org., Coal Res. Sect. Ref. T. C. 25, p. 24, pl. 4, figs. 50, 51.

1963 Foveotriletes parviretus (Balme) Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 42, pl. 6, figs. 8-13.

1967 Foveotriletes parviretus (Balme) Dettmann. Deák et Combaz, Rev. Micropal., vol. 10, no. 2, p. 74, pl. 1, fig. 12.

Remarks. F. parviretus was recorded from too few samples from either core to be statistically analyzed.

Foveotriletes subtriangularis Brenner 1963

Plate 4, Figures 17, 18

1963 Foveotriletes subtriangularis Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 62, pl. 16, fig. 2.

1966 Foveotriletes subtriangularis Brenner. Burger, Leid. Geol. Meded., vol. 35, p. 246, pl. 14, fig. 1.

Remarks. Frequency of occurrence of this species remained constant throughout the samples examined from both cores. It was not considered biostratigraphically important.

Genus Klukisporites Couper 1958

1958 Klukisporites Couper, Paleontographica, Abt. B, vol. 103, p. 137.

Type species: Klukisporites variegatus Couper 1958.

Klukisporites pseudoreticulatus Couper 1958

Plate 4, Figures 19-22

1958 Klukisporites pseudoreticulatus Couper, Palaeontographica, Abt. B, vol. 103, p. 138, pl. 19, figs. 8-10.

1962 Klukisporites pseudoreticulatus Couper. Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, p. 146, pl. 2, figs. 2-5.

1962 Dictytriletes (Klukisporites) pseudoreticulatus (Couper) Pocock, Palaeontographica, Abt. B, vol. 11, p. 41, pl. 3, figs. 46, 47.

1963 Klukisporites pseudoreticulatus Couper. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 51-52, pl. 10, fig. 5.

1965 Ischyosporites pseudoreticulatus (Couper 1958) Döring, Beih. Geol. Zeit., vol. 47, pp. 42-43, pl. 22, figs. 5, 6.

Remarks. The distal luminae characteristic of the genus are highly irregular in this species.

Frequency of occurrence was controlled by changes in depth in both cores, but a highly significant amount of variation was detected from sample to sample of the same lithologic unit. The biostratigraphic value of the species lies in its restricted range. Although it first appeared in the lowest sample in the Boykin core hole, its last occurrence was detected in Florizone C in both cores.

Genus Retitriletes Pierce 1961

1961 Retitriletes Pierce, Minn. Geol. Survey, Bull. 42, p. 29.

Type species: Retitriletes globosus Pierce 1961.

Remarks. The frequency of occurrence of this genus was controlled by changes in depth and sorting coefficient in Webb No. 1, but by changes in depth along in Boykin No. 2. Therefore, it was not considered to be biostratigraphically important.

Retitriletes pluricellulus Pierce 1961

Plate 5, Figure 1

1961 Retitriletes pluricellulus Pierce, Minn. Geol. Survey, Bull. 42, p. 29, pl. 1, fig. 16.

Remarks. The species was recorded only from Boykin No. 2, where its frequency of occurrence was controlled by changes in depth.

Retitriletes cenomanianus Agasie 1969

Plate 5, Figures 2-4

1969 Retitriletes cenomanianus Agasie, Micropaleontology, vol. 15, no. 1, pp. 24-25, pl. 3, figs. 9, 10.

Remarks. R. cenomanianus can be distinguished from R. pluricellulus by its smaller size and lack of a discernable wall.

Frequency of occurrence was controlled by changes in depth in Boykin No. 2, but by changes in both depth and

sorting coefficient in Webb No. 1. It was not considered biostratigraphically important.

Genus Costatoperforosporites Deák 1962

1962 Costatoperforosporites Deák, Foldtani Kozlony, vol. 92, no. 2, p. 231.

Type species: Costatoperforosporites fistulosus Deák 1962.

Costatoperforosporites spp.

Plate 5, Figures 5-7

Remarks. Several distinct morphological forms, all possessing regularly perforated muri were recovered from the samples examined. The size and spacing of the fovae might form a suitable basis for separating the forms into distinct species.

The frequency of occurrence of these forms was controlled by changes in depth in both cores. The first occur in Florizone A, and last appear in Florizone C.

Genus Taurocusporites Stover 1962

1962 Taurocusporites Stover, Micropaleontology, vol. 8, no. 1, pp. 55-56.

Type species: Taurocusporites segmentatus Stover 1962.

Taurocusporites segmentatus Stover 1962

Plate 5, Figure 8

1962 Taurocusporites segmentatus Stover, Micropaleontology,

vol. 8, no. 1, p. 56, pl. 1, figs. 1-4, text-fig. 1.

1963 Taurocusporites segmentatus Stover. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 69, pl. 22, Fig. 1.

1966 Taurocusporites segmentatus Stover. Archangelsky and Gamerro, Ameghiniana, vol. 4, no. 7, p. 232, pl. 2, figs. 4-6.

1967 Taurocusporites cf. T. segmentatus Stover. Drugg, Palaeontographica, Abt. B, vol. 120, p. 41, pl. 7, fig. 2.

Remarks. Specimens assigned to this species were recorded from too few samples to allow analysis.

Taurocusporites reduncus (Bolkhovitina 1953) Stover 1962

Plate 5, Figure 9

1953 Chomotriletes reduncus Bolkhovitina, Trudy Inst. Geol. Sci., Akad. Sci. S.S.S.R., no. 145, Geol. Ser. no. 61, p. 35, pl. 3, figs. 23, 24.

1962 Taurocusporites reduncus (Bolkhovitina 1953) Stover, Micropaleontology, vol. 8, no. 1, p. 57, pl. 1, figs. 15-21.

1963 Taurocusporites reduncus (Bolkhovitina) Stover. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 69, pl. 20, fig. 8; pl. 21, fig. 1.

1967 Taurocusporites reduncus (Bolkhovitina) Stover. Drugg, Palaeontographica, Abt. B, vol. 120, p. 40, pl. 7, fig. 1.

Remarks. Only two specimens were recovered, but the species is distinct enough to make a specific designation with assurance.

Taurocusporites sp.

Plate 5, Figure 10

Remarks. Only one specimen was recorded which was assignable to the genus Taurocusporites, but specific assignment was impossible.

Unidentified Muronate Sporomorph 1

Plate 6, Figure 4

Remarks. The large size of this miospore allows easy recognition.

No specimens assigned to this species were recorded from the Boykin core, although its frequency of occurrence was controlled by depth in Webb No. 1. The species was not considered biostratigraphically important.

Unidentified Muronate Sporomorph 2

Plate 4, Figure 4

Remarks. This species probably belongs to the genus Cicatricosisporites, but too few specimens were recovered to make assignment positive.

No specimens were recovered from the Webb No. 1.

Unidentified Muronate Sporomorph 3

Plate 5, Figures 12, 13

Remarks. Specimens assigned to this species have a muronate structure on the distal surface only. The laesurae are not straight, and terminate before reaching the equator.

The frequency of occurrence remained constant throughout its range in both cores.

Unidentified Muronate Sporomorph 4

Plate 5, Figure 11

Remarks. This species resembles Cicatricosisporites aralica (Bolkhovitina 1961) Brenner 1963, but is much smaller in size.

No prediction equation for frequency of occurrence could be determined for Webb No. 1, but the frequency of occurrence was controlled by changes in depth in Boykin No. 2.

Unidentified Muronate Sporomorph 5

Plate 5, Figure 14

Remarks. Only one specimen was recovered, and this was not within the data collected for analysis. There is a possibility that the individual illustrated here is a corroded form of Unidentified Muronate Sporomorph 4.

Unidentified Muronate Sporomorph 6

Plate 5, Figure 15

Remarks. These forms superficially resemble Gleicheniidites apilobatus Brenner 1963, but are smaller in size and do not display interradial thickenings.

No forms assigned to this species were recorded within the data collected for analysis.

Unidentified Muronate Sporomorph 7

Plate 5, Figure 16

Remarks. Only one specimen assigned was observed, but not within the data collected for analysis.

The exine of this Sporomorph is sculptured by stellate-like structural elements in the form of straight muri which radiate out from various centers on the surface of the exine.

Unidentified Muronate Sporomorph 8

Plate 5, Figure 17

Remarks. The presence of muri which parallel the equator on the distal surface, and the enclosure of the commissures by a thick margo characterize this Sporomorph.

No analyses were performed on the frequency of occurrence of this species, as it was not observed within the data collected for analysis.

Subturma MONOLETES Ibrahim 1933

Remarks. Charagmes which possess a monolete aperture are assigned to this subturma.

The frequency of occurrence of this subturma is controlled by changes in depth in both cores examined. The response surfaces generated show a quadratic effect with changes in depth.

Infraturma LAEVIGATOMONOLETI Dybova and Jackowicz 1957

Remarks. Monolete genera which possess a non-muronate, non-apiculate sculpture are assigned to this infraturma.

The infraturma shows a quadratic effect of changes in depth.

Genus Laevigatosporites Ibrahim 1932
emend. Schopf, Wilson and Bentall 1944

1932 Laevigatosporites Ibrahim in R. Potonié, Ibrahim and Loose, Neues Jb. Min., vol. 67, pt. B, p. 39.

1944 Laevigatosporites Ibrahim emend. Schopf, Wilson and Bentall, Ill. Geol. Survey, Rept. Invest. no. 91, p. 36.

Type species: Laevigatosporites vulgaris (Ibrahim 1932) Ibrahim 1933.

Remarks. Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin core holes, but the response surface differs from core to core. As

correlations could not be established on the basis of its range, nor on changes in the frequency of occurrence, it was not considered biostratigraphically important.

Laevigatosporites ovatus Wilson and Webster 1946

Plate 5, Figures 18, 19

1946 Laevigatosporites ovatus Wilson and Webster, Amer. Jour. Bot., vol. 33, p. 273, fig. 5.

1957 Laevigato-sporites ovatus Wilson and Webster. Rouse, Can. Jour. Bot., vol. 35, p. 355, pl. 1, fig. 3; pl. 2, figs. 19, 20.

1962 Laevigatosporites ovatus Wilson & Webster. Pocock, Palaeontographica, Abt. B, vol. 111, p. 58, pl. 8, figs. 131, 132 (not 130).

1963 Laevigatosporites ovatus Wilson & Webster. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 86, pl. 19, figs. 9-11.

1965 Laevigatosporites ovatus Wilson and Webster. Stanley, Bull. Maer. Paleont., vol. 46, no. 222, p. 253, pl. 32, figs. 4-6.

1966 Laevigatosporites ovatus Wilson and Webster 1946. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 514, pl. 4, figs. 3, 4.

1967 Laevigatosporites ovatus Wilson & Webster. Drugg, Palaeontographica, Abt. B, vol. 120, p. 43, pl. 7, fig. 5.

1969 Laevigatosporites ovatus Wilson and Webster, 1946. Lohrengel, Brigham Young Univ. Geol. Studies, vol. 16, pt. 3, p. 102, pl. 1, fig. 7.

Remarks. Frequency of occurrence was controlled by changes in depth in both cores, but the response surface was different in each core. Its biostratigraphic importance is uncertain.

Laevigatosporites albertensis Rouse 1957

Plate 5, Figure 20

1957 Laevigato-sporites albertensis Rouse, Can. Jour. Bot., vol. 35, p. 363, pl. 2, figs. 17, 18.

1966 Laevigatosporites albertensis Rouse 1957. Srivastava, Pollen et Spores, vol. 8, no. 3, pp. 512-513, pl. 3, fig. 16.

Remarks. The relatively thick exine readily distinguishes this species from Laevigatosporites ovatus Wilson and Webster 1946.

The frequency of occurrence of this species remained constant throughout its range in both cores.

Genus Petalosporites Agasie 1969

1969 Petalosporites Agasie, Micropaleontology, vol. 15, no. 1, p. 24.

Type species: Petalosporites quadrangulus Agasie 1969.

Petalosporites quadrangulus Agasie 1969

Plate 6, Figure 1

1969 Petalosporites quadrangulus Agasie, Micropaleontology, vol. 15, no. 1, p. 24, pl. 3, figs. 5-7.

Remarks. Only one specimen was assigned to this species.

Genus Monolites Cookson 1947 ex R. Potonié 1956

1947 Monolites Cookson, B.A.N.Z. Antarct. Res. Exped. (1929-1931), Rept. Ser. A (Geol.), vol. 2, p. 135.

1956 Monolites (Erdtman 1947, Cookson 1947, Chitaley 1951) ex R. Potonié, Beih. Geol. Jb., vol. 23, p. 77.

Type species: Monolites major Cookson 1947.

Monolites intragranulosus Singh, Srivastava and Roy 1963

Plate 6, Figures 2, 5

1963 Monolites intragranulosus Singh, Srivastava and Roy, The Palaeobotanist, Lucknow, vol. 12, no. 3, p. 296, pl. 6, figs. 81, 82.

Remarks. This species is distinguished from other Monolites by its relatively larger size and its infragranulate (scabrate) sculpture.

The frequency of occurrence of the species was controlled by changes in both depth and median grain size in Webb No. 1, but changes in depth alone in Boykin No. 2. Thus, it is of no biostratigraphic importance.

Infraturma SCULPTUROMONOLETI Dybova and Jackowicz 1957

Remarks. Monoletes which possess a muronate or apiculate sculpture are placed in this infraturma.

Only one muronate species was recorded from the samples examined.

Genus Verrucatosporites Pflug 1952 ex Thomson and Pflug 1953

1952 Verrucatosporites Pflug, Paläont. Zeit., vol. 26, p.

1953 Verrucatosporites Pflug ex Thomson and Pflug, Palaeontographica, Abt. B, vol. 91, p. 59.

Type species: Verrucatosporites alienus (R. Potonié 1931) Thomson and Pflug 1953.

Verrucatosporites pseudoreticulatus Hedlund 1966

Plate 6, Figure 3

1966 Verrucatosporites pseudoreticulatus Hedlund, Okla. Geol. Survey, Bull. 112, p. 21, pl. 5, figs. 7a, b.

Remarks. Frequency of occurrence was controlled by changes in median grain size in Boykin No. 2, but remained constant throughout its range in the Webb No. 1.

Turma ZONALES (Bennie and Kidston 1886)

R. Potonié 1956

Remarks. This turma includes Sporites that have a slit aperture and an equatorial thickening or thinning. The union structure may be surrounding or non-surrounding.

Forms in which the thickening covers the whole of the proximal or distal hemisphere are also included in the Zonales.

Subturma ZONOTRILETES Valts 1955

Remarks. Zonales that possess a surrounding or non-surrounding, equatorial thickening or thinning are included in this subturma.

Frequency of occurrence shows a highly significant amount of variation from sample to sample of the same lithologic unit. In addition, it was controlled by changes in depth in both cores. The response surface differed in each core. Thus, it was not used in establishing florizones.

Infraturma ZONATI R. Potonié and Kremp 1954

Remarks. Zonotriletes which possess an outer, equatorially surrounding thinning (zona) are included in this infraturma.

Frequency of occurrence was controlled by changes in depth in Webb No. 1, but by changes in depth and both grain size parameters in the Boykin No. 2. Thus it was not used in the biostratigraphic analyses.

Genus Lycopodiumsporites Thiergart 1938

1938 Lycopodiumsporites Thiergart, Jb. Preuss. Geol. L.-A. (1937) B, vol. 58, p. 293.

Type species: Lycopodiumsporites agathoecus (R. Potonié) Thiergart 1938.

Lycopodiumsporites marginatus Singh 1964

Plate 6, Figure 6

1964 Lycopodiumsporites marginatus Singh, Res. Council Alberta, Bull. 15, p. 41, pl. 1, figs. 7-10.

Remarks. Specimens assigned to this species were recorded from too few samples to subject the species to analysis.

Genus Cirratriradites Wilson and Coe 1940

1940 Cirratriradites Wilson and Coe, Amer. Midl. Natur., vol. 23, pp. 182-186.

Type species: Cirratriradites saturni (Ibrahim 1932) Schopf Wilson and Bentall 1944.

Cirratriradites teter Norris 1967

Plate 6, Figures 7, 8

1967 Cirratriradites teter Norris, Palaeontographica, Abt. B, vol. 120, pp. 98-99, pl. 14, figs. 6-10.

Remarks. Frequency of occurrence of this species was controlled by changes in depth and grain size parameters in both cores. In Webb No. 1, depth and median grain size controlled its frequency of occurrence, and in Boykin No. 2, changes in depth, median grain size and sorting coefficient controlled its frequency of occurrence.

Genus Rouseisporites Pocock 1962

1962 Rouseisporites Pocock, Palaeontographica, Abt. B, vol. 111, pp. 52-53.

Type species: Rouseisporites reticulatus Pocock 1962.

Rouseisporites sp.

Plate 6, Figure 10

Remarks. Although the frequency of occurrence of this species was controlled by changes in depth alone in Webb No. 1, no specimens were recorded from Boykin No. 2. Thus it has no biostratigraphic importance.

Unidentified Zonate Sporomorph 1

Plate 6, Figure 9

Remarks. This species is characterized by a well developed zona and by laesurae which extend to the periphery of the zona.

Frequency of occurrence was controlled by changes in depth and sorting coefficient, and a highly significant amount of variation was detected from sample to sample of the same lithologic unit, in the Webb No. 1. No specimens were recorded from Boykin No. 2. Thus, the species is of no biostratigraphic importance.

Unidentified Zonate Sporomorph 2

Plate 6, Figure 12

Remarks. Only one specimen assigned to the groups was recovered.

Infraturma CINGULATI R. Potonié and Kremp 1954

Remarks. Zonotriletes which possess an outer, equatorially surrounding thickening (cingulum) are assigned to this infraturma.

The frequency of occurrence of the infraturma displayed a highly significant amount of variation from sample to sample of the same lithologic unit, and was controlled by changes in depth and grain size parameters in both cores. It was not considered biostratigraphically important.

Genus Cingulatisporites Thomson in Thomson and Pflug 1953 emend. R. Potonié 1956

1953 Cingulatisporites Thomson in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 58.

1956 Cingulatisporites Thomson in Thomson and Pflug emend. R. Potonié, Beih. Geol. Jb., vol. 23, p. 58.

Type species: Cingulatisporites levispeciosus Pflug in Thomson and Pflug 1953.

Remarks. The frequency of occurrence of this genus was controlled by changes in depth in Webb No. 1, but by changes in median grain size in Boykin No. 2. It was of no importance in establishing florizones.

Cingulatisporites levispeciosus Pflug

in Thomson and Pflug 1953

Plate 6, Figure 13

1953 Cingulatisporites levispeciosus Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 58, pl. 1, fig. 16.

1961 Cingulatisporites levispeciosus Pflug. Pocock, Jour. Paleontology, vol. 35, no. 6, pp. 1235-1236, text-figs. A-D.

Remarks. Frequency of occurrence remained constant throughout Webb No. 1, but was controlled by changes in median grain size in Boykin No. 2. The species has no biostratigraphic importance.

Cingulatisporites sp.

Plate 6, Figure 14

Remarks. Specimens assigned to this species were recovered from too few samples to subject the species to analysis.

Genus Patellasporites Groot and Groot 1962

1962 Patellasporites Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, p. 152.

Type species: Patellasporites tavaredensis Groot and Groot 1962.

Patellasporites tavaredensis Groot and Groot 1962

Plate 7, Figures 1, 2

1962 Patellasporites tavaredensis Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, pp. 152-153, pl. 6, figs. 1, 2.

Remarks. No analyses were performed on this species, as it occurred in too few samples.

Unidentified Cingulate Sporomorph 1

Plate 6, Figure 11

Remarks. This species is easily identified by the presence of a wide cingulum surrounding the entire equator. The laesurae do not extend onto the cingulum.

Frequency of occurrence remained constant throughout the range of the species in Webb No. 1, but was controlled by changes in depth in Boykin No. 2.

Unidentified Cingulate Sporomorph 2

Plate 6, Figure 15

Remarks. This species has a narrow cingulum sculptured with recurved spines.

No specimens were recorded from Webb No. 1, but its frequency of occurrence was controlled by changes in depth in Boykin No. 2.

Unidentified Cingulate Sporomorph 3

Plate 7, Figure 3

Remarks. The cingulum which surrounds the triangular equatorial outline of this species is wider in the interradial area than at the apices. The laesurae are raised.

No analyses are presented for this species, as it was not observed within the limits of the data collected for analysis.

Unidentified Cingulate Sporomorph 4

Plate 7, Figure 4

Remarks. This sporomorph is characterized by the undulating laesurae extending onto the cingulum. Only one specimen was observed.

Unidentified Cingulate Sporomorph 5

Plate 7, Figures 5, 6

Remarks. This sporomorph has muronate sculptural elements on the distal surface only.

Too few specimens were recovered to allow further discussion of morphological features or biostratigraphic importance of this species.

Infraturma AURICULATI R. Potonié and Kremp 1954

Remarks. Zonotriletes which possess non-surrounding structures in the form of radial thickenings are included in this infraturma.

Genus Appendicisporites Weyland and Kreiger 1953

1953 Appendicisporites Weyland and Kreiger, Palaeontographica, Abt. B, vol. 95, p. 12.

Type species: Appendicisporites tricuspidatus Weyland and Greifeld 1953.

Remarks. This genus is characterized by exinal extensions protruding from the apices, and by its cicatricose structural elements. Usually one protrusion occurs at each apice, but two, three, or more may be present.

The frequency of occurrence of the genus remained constant throughout its range in both cores. Thus, it was not used to establish florizones.

Appendicisporites tricornitatus Weyland and Greifeld 1953

Plate 7, Figures 7, 8

1953 Appendicisporites tricornitatus Weyland and Greifeld, Palaeontographica, Abt. B, vol. 95, p. 43, pl. 1, fig. 52.

1955 Appendicisporites tricornitatus Weyland and Greifeld. Delcourt and Sprumont, Mem. Soc. Belge Geol., Paleont. d'Hydrol., N. S. 4, no. 5, p. 40, pl. 4, fig. 3.

1958 Appendicisporites tricornitatus Weyland and Greifeld. Couper, Palaeontographica. Abt. B, vol. 103, p. 135, pl. 17, figs. 7-9.

1960 Appendicisporites tricornitatus Weyland and Greifeld. Groot and Penny, Micropaleontology, vol. 6, no. 2, p. 230, pl. 1, fig. 4.

1961 Appendicisporites tricornitatus Weyland and Greifeld. Bolkhovitina, Trudy Geol. Inst. S.S.S.R., vol. 40, p. 60, pl. 16, figs. 9a-c.

1961 Appendicisporites tricornitatus Weyland and Greifeld 1953. Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 128, pl. 24, figs. 6, 7.

1962 Appendicisporites tricornitatus Weyland & Greifeld. Pocock, Palaeontographica, Abt. B, vol. 111, p. 38, pl. 2, figs. 24-26.

1963 Appendicisporites tricornitatus Weyland and Greifeld. Brenner, Maryland Dept. Geol., Mines, Water Res., Bull. 27, p. 47, pl. 7, fig. 3.

1964 Plicatella tricornitata (Weyl. et Greifeld) Pot. 1960. Busnardo and Taugourdeau, Rev. Micropal., vol. 7, no. 2, p. 172, pl. 1, fig. 18.

1965 Appendicisporites tricornitatus Weyland and Greifeld 1953. Döring, Beih. Geol. Zeit., vol. 47, p. 57, pl. 13, figs. 5-7.

1965 Plicatella tricornitatus (Weyland et Greifeld, 1953) Potonié, 1960. Jardiné and Magloire, Fr. Bur. Rech. Geol. Min. Mem. no. 32, p. 203, pl. 1, figs. 15, 16.

1965 Anemia tricornitata (Weyland and Greifeld) Stanley, Bull. Amer. Paleont., vol. 49, no. 222, p. 259, pl. 33, figs. 8, 9.

1966 Plicatella tricornitata (Weyland & Greifeld 1953) Potonié 1960-a. Burger, Leid. Geol. Meded., vol. 35, p. 245, pl. 13, fig. 1.

1967 Plicatella tricornitata (Weyl. et Greif.) Pot. 1960. Deak and Combaz, Rev. Micropal., vol. 10, no. 2, p. 76, pl. 3, fig. 4.

1969 Appendicisporites tricornitatus Weyland and Greifeld. Agasie, Micropaleontology, vol. 15, no. 1, p. 18, pl. 1, fig. 17.

Remarks. The frequency of occurrence of this species was controlled by neither depth nor grain size parameters in either core.

Appendicisporites ethmos Delcourt and Sprumont 1955

Plate 7, Figure 15

1955 Appendicisporites ethmos Delcourt and Sprumont, Soc. Belge Geol., Paleont. et d'Hydrol., Mem., New Ser., no. 5, p. 40, pl. 5, fig. 19.

1969 Appendicisporites ethmos Delcourt and Sprumont. Agasie, Micropaleontology, vol. 15, no. 1, p. 17, pl. 1, figs. 3, 4.

Remarks. Too few specimens were recorded from too few samples to allow analysis.

Appendicisporites unicus (Markova 1961) Singh 1964

Plate 7, Figures 9, 10, 12

1961 Anemia unica Markova in Samoilovich et al., Trudy Vses. Neft. Nauch Issled. Geol. Raszv. Inst., 177, p. 79, pl. 20, figs. 3a, b.

1964 Appendicisporites unicus (Markova) Singh, Res. Council Alberta, Bull. 15, p. 53, pl. 4, figs. 4-6.

Remarks. Although one specimen was recorded from the samples used in the analyses, this species appears to be characteristic of the lignites contained in the cores, and it might prove a highly significant environmental indicator.

Unidentified Auriculate Sporomorph 1

Plate 7, Figure 11

Remarks. Only one auriculate, laevigate specimen was recorded during this investigation.

Infraturma TRICRASSATI Dettmann 1963

Remarks. This infraturma includes those Zonotriletes which possess non-surrounding structures in the form of interradial thickenings or thinnings.

Frequency of occurrence of the infraturma was controlled by changes in depth in both cores. However, the response surface was not the same in each core, and the infraturma was not used in establishing florizones.

Genus Gleicheniidites Ross 1949

ex Delcourt and Sprumont 1955 emend. Skarby 1964

1949 Gleicheniidites Ross, Geol. Inst. Upsala, Bull. 34, p. 31, pl. 1, figs. 3, 4.

1955 Gleicheniidites Ross ex Delcourt and Sprumont, Mem. Soc. Belge Geol. Paleont. d'Hydrol., N. S. no. 5, p. 26.

1959 Gleicheniidites Ross ex Delcourt and Sprumont emend. Delcourt and Sprumont, Ann. Soc. Geol. Nord., vol. 79, p. 33.

1964 Gleicheniidites Ross emend. Skarby, Acta Univ. Stokholmensis, vol. 11, no. 3, pp. 61-65.

Type species: Gleicheniidites senonicus Ross 1949.

Remarks. Skarby (1964) presents a complete taxonomic treatment of the genus.

Frequency of occurrence of the genus was controlled by changes in depth in Webb No. 1, but remained constant throughout Boykin No. 2.

Gleicheniidites senonicus Ross 1949

Plate 7, Figures 16-19

1949 Gleicheniidites senonicus Ross, Geol. Inst. Upsala, Bull. 34, p. 31, pl. 1, figs. 3, 4.

1955 Gleicheniidites senonicus Ross, 1949, Delcourt and Sprumont, Mém. Soc. Belge Geol., Paléont. d'Hydrol., no. 5, pp. 26-27, pl. 1, fig. 5.

1958 Gleicheniidites senonicus Ross. Couper, Palaeontographica, Abt. B, vol. 103, p. 138, pl. 19, figs. 13-15.

1960 Gleicheniidites senonicus Ross, 1949. Anderson, New Mexico Bur. Mines Min. Res., Mem., vol. 6, p. 14, pl. 7, fig. 18.

1961 Cingutriletes interruptus Pierce, Minn. Geol. Survey, Bull. 42, p. 26, pl. 1, fig. 5.

1962 Gleicheniidites senonicus Ross. Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, p. 147, pl. 2, figs. 6, 7.

1962 Gleicheniidites senonicus Ross. Pocock, Palaeontographica, Abt. B, vol. 111, pp. 42-43, pl. 3, figs. 55, 56.

1963 Gleicheniidites senonicus Ross. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 53, pl. 11, fig. 6.

1963 Gleicheniidites indicus Singh, Srivastava and Roy, The Palaeobotanist, Lucknow, vol. 12, no. 3, pp. 284-285, pl. 2, figs. 16-18.

1964 Gleicheniidites senonicus Ross, 1949. Skarby, Acta Univ. Stokholmensis, vol. 11, no. 3, pp. 65-73, pl. 1, figs. 1-3; pl. 2, figs. 1-8; pl. 3, figs. 1-11; text-fig. 1:1-11.

1964 Gleicheniidites triangularis Takahashi, Fac. Sci. Kyushu Univ. Mem., Ser. D, Geol., vol. 14, no. 3, p. 152, pl. 20, figs. 1-3.

1966 Gleicheniidites senonicus Ross. Burger, Leid. Geol. Meded., vol. 35, p. 239, pl. 3, fig. 4.

1966 Gleicheniidites senonicus Ross. Helal, Palaeontographica, Abt. B, vol. 117, p. 88, pl. 31, figs. 10-12.

1966 Gleicheniidites senonicus Ross. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 122, pl. 42,

fig. 7.

1969 Gleicheniidites senonicus Ross. Agasie, Micropaleontology, vol. 15, no. 1, p. 19, pl. 2, fig. 6.

1969 Gleicheniidites senonicus Ross. Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 17, pl. 1, fig. 13.

Remarks. Frequency of occurrence remained constant throughout the range of the species in both cores. It was not used to establish florizones.

Gleicheniidites sp.

Plate 7, Figures 13, 14

Remarks. This sporomorph is differentiated from Gleicheniidites senonicus Ross 1949 by a well developed margo bordering the entire length of the commissures.

No analyses were performed on this species as too few specimens from too few samples were available.

Genus Trilobosporites Pant 1954 ex R. Potonié 1956

1954 Trilobosporites Pant, Bot. Rev., vol. 20, p. 50.

1956 Trilobosporites (Pant 1954, S. 50) ex Potonié, Beih. Geol. Jb., vol. 23, p. 55.

Type species: Trilobosporites hannonicus (Delcourt and Sprumont 1955) R. Potonié 1956.

Remarks. Frequency of occurrence of Trilobosporites remained constant throughout its range in both cores, and

was not considered to be a biostratigraphically important genus.

Trilobosporites purverulentus (Verbitskaya 1962) Dettmann 1963

Plate 8, Figures 1, 2

1962 Lygodium purverulentus Verbitskaya, Trudy Lab. Geol. Ugl., Akad. Nauk S.S.S.R. 15, pl. 101, pl. 9, figs. 48a-c.

1963 Trilobosporites purverulentus (Verbitskaya) Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, pp. 60-61, pl. 13, figs. 1-5.

1966 Trilobosporites purverulentus (Verbitskaya) Dettmann. Archangelsky and Gamerro, Ameghiniana, vol. 4, no. 7, p. 231, pl. 1, figs. 4-6.

Remarks. Specimens assigned to this species were recovered from too few samples to permit analyses.

Trilobosporites sp.

Plate 8, Figures 3, 4

Remarks. This species can be differentiated from Trilobosporites perverulentus (Verbitskaya 1962) Dettmann 1963 by its smaller verrucae of the apical regions.

No specimens were recovered from Webb No. 1, and its frequency of occurrence was controlled by changes in depth in the Boykin No. 2.

Genus Camarozonosporites Pant 1954 ex R. Potonié 1956 emend. Klaus 1960

1954 Camarozonosporites Pant, Bot. Rev., vol. 20, p. 51.

1956 Camarozonosporites (Pant 1954) ex R. Potonié (vorliegende Arbeit), Beih. Geol. Jb., vol. 23, p. 65, Table 9, fig. 85.

1960 Camarozonosporites (R. Pot. 1956) emend. Klaus, Geol. Bund. Jb., vol. 5, pp. 135-136.

Type species: Camarozonosporites crotaccus (Weyland and Kreiger 1953) R. Potonié 1956.

Camarozonosporites insignis Norris 1967

Plate 4, Figures 23-26.

1967 Camarozonosporites insignis Norris, Palaeontographica, Abt. B, vol. 120, pp. 96-97, pl. 13, figs. 12-16.

Remarks. The frequency of occurrence was controlled by changes in depth in the Webb No. 1, but no specimens were recorded from Boykin No. 2.

Genus Applanopsis Döring 1961 emend. Goubin, Taugourdeau and Balme 1964

1953 Zonalapollenites Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 66.

1961 Applanopsis Döring, Geol. Zeit., Beih., vol. 32, pp. 112-113.

1962 Pflugipollenites Pocock, Palaeontographica, Abt. B, vol. 111, p. 72.

1965 Applanopsis Döring emend. Goubin, Taugourdeau and Balme, Rev. Micropal., vol. 7, no. 4, p. 227.

Type species: Applanopsis lenticularis Doring 1961.

Applanopsis dampieri (Balme 1957) Döring 1961

Plate 8, Figures 5, 6

1957 Zonalopollenites dampieri Balme, Austr. Commonwealth Sci. Ind. Res. Org., Coal Res. Sect., T.C. 25, p. 32, pl. 8, figs. 88-90.

1959 Callialasporites (al. Zonalapollenites) dampieri (Balme) Dev, The Palaeobotanist, Lucknow, vol. 8, nos. 1, 2, p. 48, pl. 4, figs. 26, 27.

1961 Applanopsis dampieri (Balme) Döring, Geol. Beih., vol. 32, p. 113, pl. 16, figs. 11-15.

1962 Pflugipollenites dampieri (Balme) Pocock, Palaeontographica, Abt. B, vol. 111, p. 72, pl. 12, figs. 183, 184.

1963 Callialasporites dampieri (Balme) Dev 1961. Singh, Srivastava and Roy, The Palaeobotanist, Lucknow, vol. 12, no. 3, p. 297, pl. 7, fig. 91.

1963 Tsugaepollenites dampieri (Balme) Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 100, pl. 24, figs. 1-5.

1964 Callialasporites (al. Zonalapollenites Pflug) dampieri (Balme) Sukhdev. Varma and Rawat, Pollen et Spores, vol. 6, no. 1, p. 234, pl. 52, fig. 21.

1965 Zonalapollenites cf. dampieri Balme. Jardiné and Magloire, Fr. Bur. Rech. Geol. Min., Mem. no. 32, pl. 2, fig. 30.

1966 Applanopsis dampieri (Balme 1957) Döring. Burger, Leid. Geol. Meded., vol. 35, p. 255, pl. 27, fig. 2.

1966 Tsugaepollenites dampieri (Balme) Dettmann. Helal, Palaeontographica, Abt. B, vol. 117, p. 93, pl. 33, figs. 39-42.

1966 Pflugipollenites dampieri (Balme) Pocock. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 126, pl. 42, fig. 19.

Remarks. Goubin, Taugourdeau and Balme (1965) give a detailed taxonomic history of this species.

Frequency of occurrence remained constant throughout all the samples examined from both cores.

Genus Peromonolites Couper 1953

1953 Peromonolites Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 32.

Type species: Peromonolites bowenii Couper 1953.

Peromonolites allenensis Brenner 1963

Plate 8, Figures 9-12

1963 Peromonolites allenensis Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 73-74, pl. 24, figs. 12, 13.

Remarks. Hedlund (1966) reported the occurrence of a similar species from the Cenomanian of Oklahoma under the name of Aratrisporites monosaccatus Hedlund 1966. He (1966) considered that species saccate (i.e., possessing an exinal separation which takes place between the columellae and tectum), which would differentiate it from the species reported here.

Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. In Webb No. 1, its frequency of occurrence was controlled by changes in depth and sorting coefficient, but by changes in depth alone in Boykin No. 2.

Genus Uvaesporites Döring 1965

1965 Uvaesporites Doring, Geol. Beih., vol. 47, p. 39.

Type species: Uvaesporites glomeratus Döring 1965.

Remarks. Frequency of occurrence was controlled by changes in depth in the Webb No. 1, and by changes in depth and sorting coefficient in the Boykin No. 2.

Uvaesporites glomeratus Döring 1965

Plate 8, Figure 7

1965 Uvaesporites glomeratus Döring, Geol. Beih., vol. 47, pp. 39-40, pl. 9, figs. 1-4; pl. 10, figs. 3-7.

Remarks. The larger size and more loosely fitting velum readily distinguish this species from Uvaesporites cf. U. pseudocingulatus Doring 1965.

Although the frequency of occurrence was controlled by changes in depth alone in Webb No. 1, no specimens assigned to this species were recorded from Boykin No. 2. The species was not considered biostratigraphically important.

Uvaesporites cf. U. pseudocingulatus Döring 1965

Plate 8, Figure 8

1965 Uvaesporites pseudocingulatus Döring, Geol. Beih., vol. 47, p. 40, pl. 11, figs. 5-7.

Remarks. Frequency of occurrence of this species was controlled by changes in depth in Webb No. 1, but by changes in depth and sorting coefficient in Boykin No. 2.

Anteturma POLLENITES R. Potonie 1937

Remarks. Miospores which exhibit pores, colpi, sacci, or which are simple alete forms are included in this Anteturma.

Although the prediction equation used to characterize the frequency of occurrence of this Anteturma included the linear, quadratic and cubic effects of depth in both cores, the effect of changes in sorting coefficient was also important in Webb No. 1, rendering the Anteturma useless for biostratigraphic purposes.

Turma ALETES Ibrahim 1933

Remarks. Pollenites which do not possess an aperture

and are without sacci are included in this Turma.

Although a highly significant amount of variation was detected from sample to sample of the same lithologic unit, the frequency of occurrence of this Turma was controlled by changes in depth in both the Webb and Boykin cores. The response surface was not the same in both cores, thus, the turma was not used to establish florizones.

Subturma AZONALETES (Luber 1935) R. Potonié and Kremp 1954

Remarks. Aletes which do not have a zona or cingulum are included in the Subturma Azonaletes.

Infraturma PSILONAPITI Erdtman 1947

Remarks. Azonaletes which possess a laevigate sculpture are included in this Infraturma.

The frequency of occurrence of the Psilonapiti displayed a highly significant amount of variation from sample to sample of the same lithologic unit, and was controlled by changes in depth in both the Webb and Boykin cores. However, the response surface generated by changes in depth was not the same in both cores, and as the infraturma ranged throughout all palynomorph-yielding samples examined from the two cores, it was not used in establishing florizones.

Genus Taxodiaceaepollenites Kremp 1949

1949 Taxodiaceaepollenites Kremp, Palaeontographica, Abt. B, vol. 90, p. 59.

1950 Taxioidites Potonié, Thomson and Thiergart, Geol. Jb., vol. 65, p. 49.

Type species: Taxodiaceaepollenites hiatus (R. Potonié 1931) Kremp 1949.

Taxodiaceaepollenites hiatus (R. Potonié 1931) Kremp 1949

Plate 8, Figures 13-17

1931 Pollenites hiatus R. Potonié, Jb. Preuss. Geol. L.-A., vol. 52, p. 5, fig. 27.

1933 Pollenites hiatus Potonié. R. Potonié, Arb. Inst. Palaeobot., vol. 4, p. 27, pl. 1, fig. 30; pl. 6, fig. 4.

1933 Taxodium hiatipites Wodehouse, Bull. Torey Bot. Club, vol. 60, p. 493, fig. 19.

1934 Pollenites hiatus Potonié. Wolf, Arb. Inst. Palaeobot., vol. 5, p. 69, pl. 5, fig. 29.

1940 Pollenites hiatus Potonié. Thiergart, Brenn. Geol., no. 13, p. 30, pl. 2, fig. 10; pl. 4, fig. 8; pl. 5, fig. 4; pl. 10, fig. 8.

1946 Taxoidum hiatipites Wodehouse. Wilson and Webster, Amer. Jour. Bot., vol 33, p. 275, fig. 6.

1949 Taxodiaceaepollenites hiatus (Potonié) Kremp, Palaeontographica, Abt. B, vol. 90, p. 59.

1950 Taxioidites hiatus (Potonié) Potonié, Thomson and Thiergart, Geol. Jb., vol. 65, p. 49, pl. A, fig. 23.

1951 Taxodioipollenites hiatus (Potonié) R. Potonié, Palaeontographica, Abt. B, vol. 91, p. 143, fig. 17.

1953 Inaperturopollenites hiatus (Potonié) Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 65, pl. 5, figs. 14-20.

1957 Taxodium hiatipites Wodehouse. Rouse, Can. Jour. Bot., vol. 35, p. 366, pl. 2, figs. 25, 26.

1960 Inaperturopollenites hiatus (R. Potonié) Pflug and Thomson. Groot and Penny, Micropaleontology, vol. 6, no. 2, p. 231, pl. 2, fig. 19.

1961 Inaperturopollenites hiatus (R. Potonié) Pflug and Thomson 1953. Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 130, pl. 24, fig. 16.

1962 Taxodium hiatipites Wodehouse. Rouse, Micropaleontology, vol. 8, no. 2, p. 201, pl. 2, fig. 4.

1965 Thuja ? hiatus (Potonié) Stanley, Bull. Amer. Paleont., vol. 49, no. 222, p. 273, pl. 38, figs. 1-3.

1966 Taxodiaceaepollenites hiatus Kremp 1949. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 519, pl. 5, figs. 8-9.

1967 Taxodiaceaepollenites hiatus (Pot. 1934) Pot. 1958. Deák and Combaz, Rev. Micropal., vol. 10, no. 2, p. 83, pl. 3, fig. 18.

1967 Taxodiaceaepollenites hiatus (R. Potonié) Kremp. Drugg, Palaeontographica, Abt. B, vol. 120, p. 46,

pl. 7, fig. 9.

1969 Taxodiaceaepollenites hiatus Kremp. Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 32, pl. 3, fig. 15.

Remarks. This species is characterized by a relatively rigid exine which is always split open.

Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. In addition, it was controlled by changes in depth in both cores. Because the response surface to changes in depth were not the same in both cores, and this species was recorded from every sample examined, it was not considered biostratigraphically important.

Genus Laricoidites R. Potonié, Thomson and Thiergart 1950

1950 Laricoidites R. Potonie, Thomson and Thiergart, Geol. Jb., vol. 65, p. 48.

Type species: Laricoidites magnus (R. Potonié 1931) R. Potonié, Thomson and Thiergart 1950.

Laricoidites magnus (R. Potonié 1931) R. Potonié, Thomson and Thiergart 1950

Plate 9, Figure 1

1931 Sporites magnus R. Potonié, Braunkohle, vol. 30, p. 556, fig. 6.

1934 Pollenites magnus (Potonié 1931) R.Potonié, Arb. Inst. Palaont., Petrogr. Brenn., vol. 4, p. 48, pl. 6, fig. 5.

1937 Larix-pollenites magnus (Potonié) Raatz, Arb. Preuss. Geol. L.-A.N.F., vol. 183, p. 15.

1950 Laricoidites magnus (Potonié) R. Potonié, Thomson and Thiergart, Geol. Jb., vol. 65, p. 48.

1953 Inaperturopollenites magnus (Potonié 1931) Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 64, pl. 4, figs. 83-88.

1963 Laricoidites magnus (Potonié) Potonié, Thomson and Thiergart. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 88, pl. 37, figs. 1, 2.

1965 Laricoidites magnus (Potonié) Potonié, Thomson and Thiergart. Stanley, Bull. Amer. Paleont., vol. 49, no. 222, p. 278, pl. 40, figs. 8, 9.

1969 Laricoidites magnus (Potonié, 1931) Potonié, Thomson and Thiergart, 1950. Lohrengel, Brigham Young Univ. Geol. Studies, vol. 16, pt. 3, pp. 129-130, pl. 7, fig. 8.

Remarks. The large size and thick exine are the most diagnostic characteristics of the species.

Frequency of occurrence remained constant throughout the range of the species in both the Webb and Boykin cores. It was not used in establishing florizones.

Genus Inaperturopollenites Pflug and Thomson in Thomson and Pflug 1953

1953 Inaperturopollenites Pflug and Thomson in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 64.

Type species: Inaperturopollenites dubius (R. Potonié and Venitz 1934) Thomson and Pflug 1953

Inaperturopollenites dubius (R. Potonié and Venitz 1934) Thomson and Pflug 1953

Plate 8, Figures 18-22

1934 Pollenites magnus dubius R. Potonié and Venitz, Arb. Inst. Palaobot. Petrogr. Brenn., vol. 5, p. 17, pl. 2, fig. 21.

1953 Inaperturopollenites dubius (R. Pot. & Ven.) Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 65, figs. 1-13.

1953 Pollenites magnus dubius R. Pot. Thiergart, Palaeontographica, Abt. B, vol. 95, p. 57, pl. 14, figs. 19-25.

1954 M_4 - cf. Pollenites magnus dubius R. Potonié and Venitz, 1934. Radforth and Rouse, Can. Jour. Bot., vol. 32, p. 194, pl. 1, fig. 21.

1960 Inaperturopollenites dubius Potonié and Venitz. Groot and Penny, Micropaleontology, vol. 6, no. 2, p. 232, pl. 2, figs. 16, 17.

1961 Inaperturopollenites dubius Pflug and Thomson 1953. Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 130, pl. 24, fig. 15.

1962 Inaperturopollenites dubius (R. Potonié) Pflug and Thomson. Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, p. 159, pl. 6, fig. 12.

1963 Inaperturopollenites dubius (Potonié and Venitz) Thomson and Pflug. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 87-88, pl. 35, figs. 5, 6.

1965 Inaperturopollenites dubius (R. Potonié and Venitz) Thomson and Pflug 1953. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 520, pl. 4, fig. 18; pl. 5, figs. 12, 14.

1969 Inaperturopollenites dubius (Potonié and Venitz), Pflug and Thomson in Thomson and Pflug, 1953. Lohrengel, Brigham Young Univ. Geol. Studies, vol. 16, pt. 3, pp. 128-129, pl. 7, fig. 7.

Remarks. Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin cores. In addition, a significant amount of variation was detected from sample to sample of the same lithologic unit. Because the response surface differed in each core, and the species was represented in all samples examined, it was not used in the establishment of florizones.

Genus Araucariacites Cookson 1947 ex Couper 1953

1947 Araucariacites Cookson, B.A.N.Z. Antarct. Res. Exped. (1929-1931) Rept. A2 (Geol.), pt. 8, p. 130, pl. 13, figs. 1-4.

1953 Araucariacites Cookson ex Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 39.

Type species: Araucariacites australis Cookson 1947.

Araucariacites australis Cookson 1947

Plate 9, Figures 2, 3

1947 Araucariacites australis Cookson, B.A.N.Z. Antarct. Res. Exped. (1929-1931) Rept. A2 (Geol.) pt. 8, pp. 130-131, pl. 13, figs. 1-4.

1953 Araucariacites cf. A. australis Cookson. Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 39.

1957 Araucariacites australis Cookson. Balme Austr. Commonwealth Sci. Ind. Res. Org., Coal Res. Sect. Ref. T. C. 25, p. 31, pl. 7, figs. 81, 82.

1958 Araucariacites australis Cookson. Couper, Palaeontographica, Abt. B, vol. 103, p. 151, pl. 27, figs. 3-5.

1962 Araucariacites australis Cookson. Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, p. 159, pl. 7, fig. 1.

1963 Araucariacites australis Cookson. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, pp. 105-106, pl. 26, fig. 15.

1963 Araucariacites australis Cooks. 1947. Singh, Srivastava and Roy, the Palaeobotanist, Lucknow, vol. 12, no. 3, p. 299, pl. 8, fig. 113.

1965 Araucariacites australis Cookson. Jardiné and Magloire, Fr. Bur. Rech. Geol. Min., Mem. no. 32, p. 210, pl. 7, fig. 1.

1966 Araucariacites australis Cookson. Helal, Palaeontographica, Abt. B, vol. 117, p. 92, pl. 33, figs. 35-37.

1966 Araucariacites australis Cookson. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 125, pl. 42, fig. 15.

1966 Araucariacites australis Cookson. Muller, Micropaleontology, vol. 14, no. 1, p. 10, pl. 2, fig. 10.

1966 Araucariacites australis Cookson 1947. Srivastava, Pollen et Spores, vol. 8, no. 3, p. 520, pl. 5, figs. 11, 13.

1969 Araucariacites australis Cookson, 1947. Lohrengel, Brigham Young Univ. Geol. Studies, vol. 16, pt. 3, pp. 127-128, pl. 7, fig. 6.

Remarks. Frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1, but by changes in depth alone in Boykin No. 2. Thus it was not considered a biostratigraphically important species.

Subturma ZONALETES Luber 1935

Remarks. Aletes which possess a cingulum or zona are included in this subturma.

Infraturma ZONALETI Luber 1935

Remarks. This infraturma is characterized by Zonaletes which possess a cingulum or zona.

Genus Perinopollenites Couper 1958

1958 Perinopollenites Couper, Palaeontographica, Abt. B, vol. 103, p. 152.

Type species: Perinopollenites elatoides Couper 1958.

Perinopollenites elatoides Couper 1958

Plate 8, Figures 23-26

1958 Perinopollenites elatoides Couper, Palaeontographica, Abt. B, vol. 103, p. 152, pl. 27, figs. 9-11.

1962 Perinopollenites elatoides Couper. Pocock, Palaeontographica, Abt. B, vol. 111, p. 60, pl. 9, figs. 136, 137.

1963 Perinopollenites elatoides Couper. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 88, pl. 35, figs. 7, 8.

1966 Perinopollenites elatoides Couper. Burger, Leid. Geol. Meded., vol. 35, p. 264, pl. 37, fig. 1.

Remarks. Frequency of occurrence was controlled by changes in depth in both cores. The response surface differed in each core, and as the species ranged throughout all samples, its use in biostratigraphic correlation is limited.

Turma SACCITES Erdtman 1947

Remarks. Pollenites which possess sacci are included in this Turma.

Subturma DISACCITES Cookson 1947

Remarks. Included in this subturma are those Saccites with two sacci, symmetrically placed with regard to the central body.

Infraturma DISACCIATRILETI Leschik 1956

Remarks. This infraturma includes those disaccates in which the proximal exine is without longitudinal ribs and longitudinal striae, and without a proximal aperture. The proximal exine of the central body may be smooth or sculptured. The distal exine of the central body may have a longitudinal or transverse colpate aperture, and may be smooth or sculptured.

The frequency of occurrence of this infraturma exhibited a highly significant amount of variation from sample to sample of the same lithologic unit. In Webb No. 1 it was controlled by changes in depth and median grain size, but in Boykin No. 2, it was controlled by changes in depth, median grain size and sorting coefficient. The infraturma provided no biostratigraphically important information.

Genus Cedripites Wodehouse 1933

1933 Cedripites Wodehouse, Bull. Torey Bot. Club, vol. 60, pp. 489-490, fig. 13.

Type species: Cedripites eocenicus Wodehouse 1933.

Remarks. Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit, and was controlled by changes in depth and median grain size in Webb No. 1, but by changes in depth, median grain size and sorting coefficient in Boykin No. 2.

Cedripites cretaceus Pocock 1962

Plate 9, Figures 4, 5

1962 *Cedripites cretaceus* Pocock, Palaeontographica, Abt. B, vol. 111, p. 63, pl. 9, figs. 145, 146.

Remarks. This species is readily distinguished from *Cedripites canadensis* Pocock 1962 by the larger size of its bladders.

In addition to displaying a highly significant amount of variation from sample to sample of the same lithologic unit, the frequency of occurrence was controlled by changes in depth, median grain size and sorting coefficient in Boykin No. 2, but by changes in median grain size only in Webb No. 1. The species was not used to establish florizones.

Cedripites canadensis Pocock 1962

Plate 9, Figures 6, 7

1962 *Cedripites canadensis* Pocock, Palaeontographica, Abt. B, vol. 111, p. 63, pl. 10, figs. 149, 150.

Remarks. Frequency of occurrence was controlled by changes in depth in both cores examined. The response surface in each core was controlled by linear, quadratic and cubic effects of depth, but the direction each of these effects had on frequency of occurrence differed in each well. The species ranged throughout all zones, and is limited in biostratigraphic importance.

Genus Abietineaepollenites R. Potonié 1951

1951 Abietineaepollenites R. Potonié, Palaeontographica, Abt. B, vol. 91, p. 144.

Type species: Abietineaepollenites microalatus R. Potonié 1951.

Remarks. A highly significant amount of variation was detected from sample to sample of the same lithologic unit. In Webb No. 1, the frequency of occurrence was controlled by changes in depth alone, but in Boykin No. 2, the frequency of occurrence was controlled by changes in depth, median grain size and sorting coefficient. The genus gave no biostratigraphically important information.

Abietineaepollenites microalatus R. Potonié 1951

Plate 9, Figures 8, 9

1951 Abietineaepollenites (al. Piceae-pollenites) microalatus R. Potonié, Palaeontographica, Abt. B, vol. 91, p. 144.

1953 Pityosporites microalatus (R. Pot.) Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 67, pl. 5, figs. 47-59.

1953 Pityosporites microalatus (R. Pot.) Th. & Pf. Weyland and Kreiger, Palaeontographica, Abt. B, vol. 95, p. 14, pl. 1, figs. 23-25; pl. 5, fig. 3.

1962 Abietineaepollenites microalatus R. Potonié. Groot and Groot, Palaeontographica, Abt. B, vol. 111, p. 164, pl. 29, figs. 9, 10.

Remarks. Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. In Webb No. 1, the frequency of occurrence was controlled by changes in depth, but in Boykin No. 2, the frequency of occurrence was controlled by changes in depth, median grain size and sorting coefficient. This species was not considered to be biostratigraphically important.

Abietineaepollenites microreticulatus Groot and Penny 1960

Plate 9, Figure 10

1960 Abietineaepollenites microreticulatus Groot and Penny, Micropaleontology, vol. 6, no. 2, p. 231, pl. 1, fig. 8.

Remarks. Frequency of occurrence was controlled by changes in depth in Webb No. 1, but only by changes in median grain size in Boykin No. 2. The species is not biostratigraphically important.

Genus Alisporites Daugherty 1941

emend. R. Potonié and Kremp 1956

1941 Alisporites Daugherty, Carnegie Inst. Washington, Publ. no. 526, p. 98, pl. 34, fig. 2.

1956 Alisporites (Daugherty) R.Potonié and Kremp, Palaeontographica, Abt. B, vol. 99, pp. 176-177, fig. 2.

Type species: Alisporites opii Daugherty 1941.

Alisporites bilateralis Rouse 1959

Plate 9, Figures 11, 12

1959 Alisporites bilateralis Rouse, Micropaleontology, vol. 5, no. 3, p. 316, pl. 1, figs. 10, 11.

1963 Alisporites cf. A. bilateralis Rouse. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 78, pl. 27, figs. 3, 4.

Remarks. Although the response surface differed in the direction of the significant effects in each core, the frequency of occurrence was controlled by changes in depth for both the Webb and Boykin cores. The biostratigraphic importance of this species lies in the fact that no specimens were recorded above 238.8 feet in the Webb core, nor above 246.0 feet in the Boykin core. Therefore, the disappearance of this species is characteristic of Zone C.

Genus Caytonipollenites Couper 1958

1958 Caytonipollenites Couper, Palaeontographica, Abt. B, vol. 103, p. 149.

Type species: Caytonispollenites pallidus (Reissinger 1938) Couper 1958.

Caytonipollenites cf. C. pallidus (Reissinger 1938) Couper 1958

Plate 10, Figure 1

1938 Pityosporites pallidus Reissinger, Palaeontographica, Abt. B, vol. 84, p. 14.

1958 Caytonipollenites pallidus (Reissinger) Couper, Palaeontographica, Abt. B, vol. 103, p. 150, pl. 26, figs. 7-8.

Remarks. Frequency of occurrence remained constant throughout the range of the species in both the Webb and Boykin core holes. The species was not considered biostratigraphically important.

Genus Rugubivesiculites Pierce 1961

1961 Rugubivesiculites Pierce, Minn. Geol. Survey, Bull. 42, p. 39.

Type species: Rugubivesiculites convolutus Pierce 1961.

Remarks. The most diagnositc feature of this genus is the highly rugulate sculpturing of the proximal cap.

Frequency of occurrence was controlled by changes in depth, median grain size and sorting coefficient in

both the Webb and Boykin core holes. However, the response surface to changes in both median grain size and sorting coefficient differs in each core.

Rugubivesiculites rugosus Pierce 1961

Plate 10, Figures 2, 3

1961 Rugubivesiculites rugosus Pierce, Minn. Geol. Survey, Bull. 42, p. 40, pl. II, figs. 59, 60.

Remarks. This species is differentiated from R. Woodbinensis Hedlund 1966 by the greater degree of rugulate sculpturing on the proximal cap.

Frequency of occurrence was controlled by changes in depth in both cores. As the response surface differed in each core, the biostratigraphic importance of this species lies in its limited range. No specimens assigned to this species were recovered fromsamples above 261.0 feet in the Webb No. 1, nor above 314.2 feet in Boykin No. 2. Apparently, Rugubivesiculites rugosus Pierce 1961 disappears within Zone A.

Rugubivesiculites woodbinensis Hedlund 1966

Plate 10, Figures 4-6

1966 Rugubivesiculites woodbinensis Hedlund, Okla. Geol. Survey, Bull. 112, p. 23, pl. 7, figs. 2a, b.

1969 Rugubivesiculites woodbinensis Hedlund. Agasie, Micropaleontology, vol. 15, no. 1, p. 26, pl. 2, figs. 13, 14.

Remarks. Frequency of occurrence was controlled by changes in depth and median grain size in both the Webb and Boykin cores. However, the response surface differed in each core as only the cubic effect of depth and the negative effect of median grain size was significant in Webb No. 1, and the linear, quadratic and cubic effects of depth, and the positive effect of median grain size was significant in Boykin No. 2. Further investigation into the environmental significance of this species is suggested.

Unidentified Saccate Sporomorph 1

Plate 10, Figure 7

Remarks. This species resembles Abietineaepollenites microreticulatus Groot and Penny 1960, but is consistently larger in overall diameter.

No specimens were recovered from Webb No. 1, and the frequency of occurrence remained constant throughout its range in Boykin No. 2. The species was not included in any biostratigraphic considerations.

Unidentified Saccate Sporomorph 2

Plate 10, Figure 9

Remarks. Specimens assigned to this species were recovered from too few samples to subject the species to analysis.

Unidentified Saccate Sporomorph 3

Plate 10, Figure 8

Remarks. Specimens assigned to this species were recovered from too few samples to subject the species to analysis.

Unidentified Saccate Sporomorph 4

Plate 10, Figure 10

Remarks. Specimens assigned to this species were recovered from too few samples to subject the species to analysis.

Turma EUPOLLENITES Klaus 1960

Remarks. This Turma includes those Pollenites which display an exinal thinning which is distally, meridianally, equatorially or randomly located. In addition, a sulcus or culpus may be present.

Subturma OPERCULATI Venkatachala and Goczan 1964

Remarks. This subturma included those Eupollenites which possess a distinct operculum and a tetrad mark that is not functional as a trilete aperture. The subturma is monotypic.

Infraturma OPERCULITI Venkatachala and Góczán 1964

Remarks. As this Infraturma is the only one in the Subturma Operculati, the definition provided above serves

as the definition of the Infraturma.

Genus Classopollis Pflug 1953 emend. Couper 1958

1953 Classopollis Pflug, Palaeontographica, Abt. B, vol. 95, p. 91.

1958 Classopollis Pflug (here emended) Couper, Palaeontographica, Abt. B, vol. 103, p. 156.

Type species: Classopollis torosus (Reissinger 1950) Couper 1958.

Classopollis torosus (Reissinger 1950) Couper 1958

Plate 10, Figures 11-14

1950 Pollenites torosus Reissinger, Palaeontographica, Abt. B, vol. 90, p. 114, pl. 14, fig. 20.

1953 Classopollis classoides Pflug, Palaeontographica, Abt. B, vol. 95, p. 91, pl. 16, figs. 20-25, 29-37.

1958 Classopollis torosus (Reissinger) Couper, Palaeontographica, Abt. B, vol. 103, pp. 156-157, pl. 28, figs. 2-7.

1961 Classopollis classoides Pflug emend. Pocock and Jansonius, Micropaleontology, vol. 7, no. 4, pp. 443-444, pl. 1, figs. 1-9.

1962 Classopollis classoides (Pflug) Pocock & Jansonius. Pocock, Palaeontographica, Abt. B, vol. 111, p. 71, pl. 11, figs. 171-175.

1963 Classopollis torosus (Reissinger) Couper. Brenner,

Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 84-85, pl. 34, figs. 4-6.

1963 Classopollis torosus (Reiss.) Couper 1958. Singh, Srivastava and Roy, The Palaeobotanist, Lucknow, vol. 12, no. 3, p. 301, pl. 16, figs. 134, 135.

1965 Classopollis torosus (Reissinger) Couper 1958. Deák, Geologica Hungarica, Ser. Paleont., vol. 29, p. 35, pl. 14, figs. 7, 9-17.

1965 Classopollis torosus (Reissinger 1950) Couper 1958. Döring, Beih. Geol. Zeit., vol. 47, p. 61, pl. 17, fig. 3.

1965 Classopollis classoides Pflug 1953. Jardiné and Magloire, Fr. Bur. Rech. Geol. Min., Mem. no. 32, p. 221, pl. 5, figs. 12-18.

1966 Classopollis torosus (Reissinger 1950) Couper 1958 emend. Burger 1965 al. classoides (Pflug 1953) Pocock & Jansonius 1961? Burger, Leid, Geol. Meded., vol. 35, p. 264, pl. 38, fig. 5.

1966 Classopollis sp. cf. C. classoides Pflug, emend. Pocock and Jansonius. Muller, Micropaleontology, vol. 14, no. 1, pp. 10-11, pl. 2, fig. 11.

1966 Classopollis cf. torosus (Reissinger, 1950) Couper, 1958. van der Hammen and Burger, Leid. Geol. Meded., vol. 38, p. 178, pl. 4, fig. 24.

1967 Classopollis torosus (Couper 1958) Burger 1965. Deák and Combaz, Rev. Micropal., vol. 10, no. 2, p. 84, pl. 3, fig. 14.

Remarks. Although the distal, non-functional trilete mark could not be discerned on all specimens, the proximal operculum and equatorial striations allowed the species to be easily identified.

Frequency of occurrence varied significantly from sample to sample of the same lithologic unit, and the response surface generated for the species varied from core to core. Hughes and Moody-Stuart (1967) considered Classopollis torosus to be a miospore produced by plants inhabiting coastal areas, and are concentrated in near-shore deposits. It is not surprising, then, the the frequency of occurrence of the species varied with changes in geographic location.

Turma PLICATES Naumova 1937

Remarks. Pollenites which possess colpi but are without sacci and without pores are included in this Turma.

A highly significant amount of variation was detected in frequency of occurrence from sample to sample of the same lithologic unit. In addition, it was controlled by changes in depth and sorting coefficient in Webb No. 1, but by changes in depth in Boykin No. 2. The turma was not considered biostratigraphically important.

Subturma PRAECOLPATES R. Potonié and Kremp 1954

Remarks. Plicates with a single, distal, transverse colpus and a proximal slit aperture are included in the subturma. Proximal ribs and striae may be present. The subturma is monotypic.

Infraturma PRAECOLPITI R. Potonié and Kremp 1954

Remarks. The definition of the Subturma serves as the definition of the infraturma.

Genus Eucommiidites Erdtman 1948 emend. Couper 1958

1948 Eucommiidites Erdtman, Geol. Foren. Forhandl., vol. 70, no. 2, p. 267.

1958 Eucommiidites Erdtman (here emended) Couper, Palaeontographica, Abt. B, vol. 103, p. 160.

Type species: Eucommiidites troedssonii Erdtman 1948.

Eucommiidites sp.

Plate 10, Figure 23

Remarks. This sporomorph differs from Eucommiidites troedssonii Erdtman 1948 in having a definite gemmate to clavate sculpture which is most prominent at the poles.

No specimens were recovered from Webb No. 1. However, the frequency of occurrence was controlled by changes in depth in Boykin No. 2. The species was not considered biostratigraphically important.

Subturma POLYPLICATES Erdtman 1952

Remarks. Plicates with more than two transverse colpi that lie more or less parallel to one another are included in this Subturma. The subturma is monotypic.

Infraturma POLYPLICITI Erdtman 1952

Remarks. The definition of the Subturma serves as the definition of the Infraturma.

Frequency of occurrence of the infraturma was controlled by changes in depth and sorting coefficient in Webb No. 1, but by depth alone in Boykin No. 2. The infraturma contributed no biostratigraphically important information.

Genus Ephedripites Bolkhovitina 1953

1953 Ephedripites Bolkhovitina, Trudy Inst. Geol. Nauk, Akad. Sci. S.S.S.R., Rel. 145, Geol. Ser. no. 61, p. 60.

Type species: Ephedripites mediolobatus Bolkhovitina 1953.

Remarks. The frequency of occurrence of this genus was controlled by changes in depth and sorting coefficient in Webb No. 1, but by changes in depth alone in Boykin No. 2.

Ephedripites virginiaensis Brenner 1963

Plate 10, Figure 15

1963 Ephedripites virginiaensis Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 90-91, pl. 38, fig. 3.

Remarks. This species is distinguished by its large size and number of plicae.

Frequency of occurrence remained constant throughout the range of the species in both the Webb and Boykin cores. The species was not considered to contribute any biostratigraphically important information.

Ephedripites dudarensis Deák 1965

Plate 10, Figures 16, 17

1965 Ephedripites dudarensis Deák, Geologica Hungarica, Ser. Paleont., vol. 29, pp. 33-34, pl. 13, fig. 13.

Remarks. Frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1, and by changes in depth alone in Boykin No. 2. The species was not considered when florizones were established.

Ephedripites sp.

Plate 10, Figures 21, 22

Remarks. This sporomorph is characterized by possessing plicae which extend from pole to pole, but which

are not parallel to the polar axis. A small size makes light microscopic study of the sporomorph difficult.

Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin cores. The response surface differed in each core, and the biostratigraphic importance of this species lies in its localized range. This species was first recorded from samples within Florizone A, reached its minimum abundance in Florizone B, and was last recorded from samples in Florizone C.

Genus Welwitschiapites Bolkhovitina 1953

1953 Welwitschiapites Bolkhovitina, Trudy Inst. Geol. Nauk, Akad. Sci. S.S.S.R., Rel. 145, Geol. Ser. no. 61, p. 61.

Type species: Welwitschiapites magniobolatus Bolkhovitina 1953.

Welwitschiapites virgatus Deák 1963

Plate 10, Figure 18

1963 Welwitschiapites virgatus Deák, Grana Palynolgica, vol. 4, no. 3, pp. 407-408, figs. 1, 2.

1965 Welwitschiapites virgatus Deák. Deák, Geologica Hungarica, Ser. Paleont., vol. 29, p. 34, pl. 14, fig. 1.

Remarks. Frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1,

but remained constant throughout the range of the species in Boykin No. 2. The species contributed no biostratigraphically important information.

Subturma MONOCOLPATES (Wodehouse 1935) Iversen and Troels-Smith 1950

Remarks. Plicates with a single distal transverse colpus and without a proximal aperture are included in this Subturma. The subturma is monotypic.

Infraturma MONOCOLPITI (Wodehouse 1935) Iversen and Troels-Smith 1950

Remarks. The definition presented for the subturma serves to define the infraturma.

Whereas the frequency of occurrence of this infraturma remained constant throughout its range in Boykin No. 2, it was controlled by changes in depth and sorting coefficient in Webb No. 1. The infraturma provided no biostratigraphically important information.

Genus Palmaepollenites R. Potonié 1951

1951 Palmaepollenites R. Potonié, Palaeontographica, Abt. B, vol. 91, p.

Type species: Palmaepollenites tranquillus (R. Potonié 1934) R. Potonié 1951.

Palmaepollenites tranquillus (R. Potonié 1934)
R. Potonié 1951

Plate 11, Figures 1-3

1934 Pollenites tranquillus R. Potonié, Arb. Preuss. Geol. L.-A., Inst. Palaobot., Petrogr., Brenn., vol. 4, p. 51, pl. 1, figs. 3, 8.

1951 Palmaepollenites tranquillus (R. Potonié 1934) R. Potonié, Palaeontographica, Abt. B, vol. 91, pl. 20, figs. 31, 31a.

Remarks. Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin cores. The response surface differed in each core, and as the species ranged throughout all the samples in the Boykin core, it has little biostratigraphic value.

Palmaepollenites spheroides
(Jardiné and Magloire 1965) nov. comb.

Plate 11, Figure 4

1965 Monocolpopollenites spheroides Jardiné and Magloire, Fr. Bur. Rech. Geol. Min., Mem. no. 32, pp. 211-212, pl. 8, figs. 27-30.

Remarks. Specimens assigned to this species were recovered from too few samples to allow analysis.

The genus Monocolpopollenites was erected in 1953 by Thomson and Pflug, who used the same species for the type species as had been used by Potonie (1951) when the

genus Palmaepollenites was established. Monocolpopollenites is thus a junior synonym of Palmaepollenites.

Palmaepollenites ?

Plate 11, Figure 5

Remarks. This species is differentiated from Palmaepollenites spheroides (Jardine and Magloire 1956) nov. comb. by its smaller size and prolate shape.

Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin cores. As the response surface differed in each core, and as specimens were recovered from every sample examined, this species is not considered biostratigraphically important.

Genus Cycadopites (Wodehouse 1933)
ex Wilson and Webster 1946

1933 Cycadopites Wodehouse, Torrey Bot. Club Bull., vol. 60, pp. 483-484.

1946 Cycadopites Wilson and Webster, Amer. Jour. Bot., vol. 33, pp. 244-245.

Type species: Cycadopites follicularis Wilson and Webster 1946.

Cycadopites nitidus (Balme 1957) nov. comb.

Plate 10, Figures 24, 25

1957 Entylissa nitidus Balme, Austr. Commonwealth Sci.

Ind. Res. Org., Coal Res. Sect., Ref. T. C. 25, p. 30, pl. 6, figs. 78-80.

1962 Ginkgocycadophytus nitidus (Balme) de Jersey, Qd. Dept. Mines Publ. 307, p. 12, pl. 5, figs. 1-3.

1963 Entylissa nitidus Balme. Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 74-75, pl. 25, figs. 3-4.

1963 Ginkgocycadophytus nitidus (Balme) de Jersey. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 104, pl. 26, figs. 8, 9.

1966 Ginkgocycadophytus nitidus (Balme) de Jersey. Muller, Micropaleontology, vol. 12, no. 1, p. 11, pl. 2, fig. 12.

1969 Entylissa cf. E. nitidus Balme, 1957. Lohrengel, Brigham Young Univ. Geol. Studies, vol. 16, pt. 3, p. 126, pl. 7, fig. 4.

Remarks. A significant amount of variation was detected in the frequency of occurrence of this species from sample to sample of the same lithologic unit. Frequency of occurrence was controlled by changes in depth, median grain size and sorting coefficient in Webb No. 1, but only by depth in Boykin No. 2. The species was not considered biostratigraphically important.

This writer has followed the suggestions of Jansonius (1962) who considered Ginkgocycadophytus Samoilovich 1953 a junior synonym of Cycadopites Wodehouse 1933 ex Wilson and Webster 1946.

Genus Lilicacidites Couper 1953

1953 Liliacidites Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 65.

Type species: Liliacidites kaitangataensis Couper 1953.

Liliacidites dividuus (Pierce 1961) Brenner 1963

Plate 10, Figure 20

1961 Retimonocolpites dividuus Pierce, Minn. Geol. Survey, Bull. 42, p. 27, pl. 3, fig. 87.

1963 Liliacidites dividuus (Pierce) Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, pp. 93-94, pl. 40, figs. 7-10.

Remarks. Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin core holes. The response surface differed in each core, and the biostratigraphic significance of the species lies in its localized range. The species first appeared in samples from Florizone A, reached its minimum occurrence in Florizone B, and last occurred in samples from Florizone C.

Genus Monosulcites Cookson 1947 ex Couper 1953

1947 Monosulcites Cookson, B.A.N.Z. Antarct. Res. Exped. (1929-1931), Rept. Ser. A (Geol.), vol. 2, pp. 134-135.

1953 Monosulcites Cookson ex Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 65.

Type species: Monosulcites minimus Cookson 1947.

Monosulcites chaloneri Brenner 1963

Plate 10, Figure 19

1963 Monosulcites chaloneri Brenner, Maryland Dept. Geol., Mines Water Res. Bull. 27, p. 73, pl. 24, figs. 9-11.

Remarks. Frequency of occurrence displayed a significant amount of variation from sample to sample of the same lithologic unit. In Webb No. 1 it remained constant throughout the range of the species and in Boykin No. 2, was controlled by changes in depth. The species supplied no biostratigraphically important information.

Subturma TRIPTYCHES Naumova 1937

Remarks. Plicates which possess three radially symmetrical colpi are included in this subturma. The subturma is monotypic.

Infraturma TRIPTYCHITI Naumova 1937

Remarks. The definition provided for the Subturma serves for the infraturma.

Frequency of occurrence of the Infraturma Triptychiti displayed a highly significant amount of variation from sample to sample of the same lithologic unit. In addition, it was controlled by changes in depth and sorting coefficient in Webb No. 1, but by changes in depth alone in Boykin No. 2. The infraturma was not considered biostratigraphically important.

Genus Tricolpopollenites Pflug and Thomson in Thomson and Pflug 1953

1953 Tricolpopollenites Pflug and Thomson in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 95.

Type species: Tricolpopollenites parmularius (R. Potonié 1934) Thomson and Pflug 1953.

Remarks. A highly significant amount of variation was detected from sample to sample of the same lithologic unit, and the frequency of occurrence was controlled by changes in depth, median grain size and sorting coefficient in Webb No. 1, but by changes in depth alone in Boykin No. 2. The genus contributed no biostratigraphically important information.

Tricolpopollenites parmularius (R. Potonié 1934) Thomson and Pflug 1953

Plate 11, Figures 6, 7

1934 Pollenites parmularius R. Potonié, Arb. Inst. Palaobot. Petrogr., Brenn., vol. 4, p. 52, pl. 2, fig. 7.

1951 Cornaceoipollenites (al. Pollenites) parmularius (R. Pot. 1934, 4, S. 52, Taf. 2, Fig. 7, Prap. X43 in Berlin; 26) R. Potonié, Palaeontographica, Abt. B, vol. 91, p.

1953 Tricolpopollenites parmularius (Potonié) Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 97, pl. 11, figs. 152-162.

Remarks. This species is differentiated from others by the strongly developed margo which borders the colpi along their entire length. The colpi extend nearly to the poles and are relatively straight.

Frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1, but by changes in depth and median grain size in Boykin No. 2. The species has no biostratigraphic use.

Tricolpopollenites retiformis Pflug and Thomson in Thomson and Pflug 1953

Plate 11, Figures 8, 9

1953 Tricolpopollenites retiformis Pflug and Thomson in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 97, pl. 11, fig. 59.

1961 Tricolpopollenites retiformis Pflug and Thomson 1953, Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 133, pl. 26, figs. 12, 13,

1966 Tricolpopollenites retiformis Pflug and Thomson. Gray and Groot, Palaeontographica, Abt. B, vol. 117, p. 127, pl. 43, fig. 5.

Remarks. Frequency of occurrence was controlled by changes in depth in Webb No. 1, but by changes in depth and median grain size in Boykin No. 2. The species was not used in the establishment of florizones.

Tricolpopollenites minutus Brenner 1963

Plate 11, Figures 10, 11

1963 Tricolpopollenites minutus Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 93, pl. 40, figs. 5, 6.

Remarks. The small size and prolate shape allows the species to be easily identified.

Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. However, it was controlled only by changes in depth in both the Webb and Boykin cores. The frequency of occurrence responded to changes in the quadratic and cubic effects of depth in each core, but the direction of this response differed in each core. Because the frequency of occurrence did not react in a similar fashion in both cores, and because specimens belonging to this species were recorded in all samples, this species was not considered biostratigraphically important.

Tricolpopollenites parvulus Groot and Penny 1960

Plate 11, Figures 12-14

1960 Tricolpopollenites parvulus Groot and Penny, Micropaleontology, vol. 6, no. 2, p. 232, pl. 2, figs. 8, 9.

1961 Tricolpopollenites parvulus Groot and Penny. Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108,

p. 132, pl. 26, figs. 3, 4.

1967 Psilatricolpites parvulus (Groot & Penny) Norris, Palaeontolographica, Abt. B, vol. 120, p. 107, pl. 17, figs. 5, 6.

1969 Tricolpopollenites parvulus Groot and Penny, 1960. Lohrengel, Brigham Young Univ. Geol. Studies, vol. 16, pt. 3, p. 158, pl. 12, fig. 2.

Remarks. The polar regions of this species are somewhat truncated, allowing the species to be easily recognized.

Frequency of occurrence of this species was controlled by changes in depth and sorting coefficient in the Webb core, but by changes in depth and median grain size in the Boykin core. The species was not biostratigraphically important.

Tricolpopollenites elongatus Groot and Groot 1962

Plate 11, Figure 15

1962 Tricolpopollenites elongatus Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 26, p. 164, pl. 9, fig. 1.

Remarks. This species is highly prolate, with a length-wide ratio which equals or exceeds 2:1.

Whereas the frequency of occurrence of this species was controlled by changes in depth and sorting coefficient in Webb No. 1, it was controlled by changes in depth alone in Boykin No. 2.

Genus Retitricolpites van der Hammen 1956

1956 Retitricolpites van der Hammen, Bol. Geol. Bogata, vol. 4, p. 93.

Type species: Retitricolpites ornatus van der Hammen 1956.

Remarks. A highly significant amount of variation in frequency of occurrence was detected from sample to sample of the same lithologic unit. Frequency of occurrence was controlled by changes in depth in Webb No. 1, and by changes in depth and median grain size in Boykin No. 2. The genus provided no biostratigraphically important information.

Retitricolpites virgeus (Groot, Penny and Groot 1961) Brenner 1963

Plate 11, Figure 19

1961 Tricolpopollenites virgeus Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 133, pl. 26, figs. 16, 17.

1963 Retitricolpites virgeus (Groot, Penny and Groot) Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 92, pl. 39, figs. 4, 5.

Remarks. Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. In addition, it remained constant throughout Webb No. 1, but was controlled by changes in depth in Boykin No. 2. The species was not considered biostratigraphically important.

Retitricolpites cf. R. georgensis Brenner 1963

Plate 11, Figures 16-18

1963 Retitricolpites georgensis Brenner, Maryland Dept. Geol., Mines Water Res., Bull. 27, p. 91, pl. 38, figs. 6, 7.

Remarks. The specimens assigned to this species appear smaller than those described by Brenner (1963), and have tentatively been placed in this species. They are much smaller than R. virgeus.

A highly significant amount of variation was detected in the frequency of occurrence of this species from sample to sample of the same lithologic unit. Thr frequency of occurrence was controlled by changes in depth alone in Webb No. 1, but by changes in depth and median grain size in Boykin No. 2. The species was not considered biostratigraphically important.

Genus Tricolpites Erdtman 1947 ex Couper 1953 emend. R. Potonié 1960

1947 Tricolpites Erdtman, Svensk. Bot. Tidskr., vol. 41, no. 1, p. 109.

1953 Tricolpites Erdtman ex Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 61.

1960 Tricolpites (Erdtman 1947, S. 109, Cookson 1947, Ross 1949, S. 36) Couper 1953 emend. R. Potonié, Beih. Geol. Jb., vol. 39, p. 95.

Type species: Tricolpites reticulatus Cookson 1947 ex Couper 1953.

Remarks. There is a strong possibility that this genus may be environmentally controlled. Its frequency of occurrence was controlled by changes in sorting coefficient in both cores. In addition, it was controlled by changes in depth in Webb No. 1. The direction of the change in frequency of occurrence with a unit change in sorting coefficient is positive in both wells. Further investigation into the environmental significance of this genus is necessary before any definite conclusions concerning its importance can be made.

Tricolpites microreticulatus

Belsky, Boltenhagen and R. Potonié 1965

Plate 11, Figure 20

1965 Tricolpites microreticulatus Belsky, Boltenhagen and R. Potonié, Paläont. Zeit., vol. 39, pp. 75-76, pl. 12, figs. 8, 9.

Remarks. This species can be differentiated from others belonging to the genus Tricolpites by its finly reticulate sculpture.

Frequency of occurrence was controlled by changes in depth in Webb No. 1, and by changes in depth and sorting coefficient in Boykin No. 2. The species was not considered biostratigraphically important.

Tricolpites tienabaensis Jardiné and Magloire 1965

Plate 11, Figures 21, 22

1965 Tricolpites tienabaensis Jardiné and Magloire, Fr. Bur. Rech. Geol. Min., Mem. no. 32. p. 216, pl. 10, figs. 60, 61.

Remarks. Frequency of occurrence was controlled by changes in depth in Webb No. 1 and remained constant throughout its range in Boykin No. 2. No biostratigraphic importance was attached to this species.

Tricolpites wilsonii Kimyai 1966

Plate 11, Figure 23

1966 Tricolpites wilsonii Kimyai, Micropaleontology, vol. 12, no. 4, p. 471, pl. 2, fig. 18.

Remarks. This species can be differentiated from other species in the genus by its shape which is more triangular in polar view, and by its reticulate sculpture which is coarser at the equator than at the poles. Although this feature is not discussed by Kimyai, his illustration of the holotype clearly indicates that this characteristic is common to the species.

Frequency of occurrence was controlled by changes in sorting coefficient in Webb No. 1, but remained constant throughout its range in Boykin No. 2. This species provided no biostratigraphically important information.

Tricolpites spp.

Plate 11, Figures 24, 25

Remarks. This heterogenous group of miospores have the following characteristics in common: (1) their equatorial outline is circular, (2) their exine is relatively thin, and (3) thier colpi extend nearly to the poles and are open. Jardine and Magloire (1965) reported finding similar miospores in Cretaceous rocks from Senegal, Africa.

The frequency of occurrence of this species displayed a highly significant amount of variation from sample to sample of the same lithologic unit. This was not surprising, as the group is probably polymorphic. Frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1 and by changes in depth alone in Boykin No. 2. No biostratigraphic importance was attached to this group.

Genus Latipollis Krutzsch 1959

1959 Latipollis Krutzsch, Palaeontographica, Abt. B, vol. 105, p. 128.

Type species: Latipollis subtilis Krutzsch 1959.

Remarks. This genus is easily recognized by the presence of colpi at the ends of equatorial protrusions.

The frequency of occurrence of this genus was controlled by changes in depth and sorting coefficient in Webb No. 1, and by changes in depth and median grain size in Boykin No. 2.

Although no reliable biostratigraphic correlations could be made on the basis of this genus because of the possible influence of environmental controls on its distribution, the genus might reflect a group of phylogenetically related species. The response surface for the three species assigned to the genus in Webb No. 1 reflects changes in the linear, quadratic and cubic effects of depth as well as changes in sorting coefficient. In Boykin No. 2, two of the three species were controlled by changes in the quadratic and cubic effects of depth. The third species (Latipollis verrucosus Groot and Groot 1962) displayed no variation throughout its range in Boykin No. 2, probably because of the large amount of variation displayed from sample to sample of the same lithologic unit. The similarity in the response surface is interpreted as indicating a relationship which is more than just morphological. It is expected that morphologically related species would vary according to changes in environmental controls, but similarities in the response surface to changes in depth would be expected from phylogenetically related species.

Latipollis normis Krutzsch 1959

Plate 11, Figures 26-28

1959 Latipollis normis Krutzsch, Palaeontographica, Abt. B, vol. 105, pp. 129-130, pl. 31, figs. 20-26.

1961 Latipollis normis Krutzsch. Groot, Penny and Groot, Palaeontographica, Abt. B, vol. 108, p. 137, pl. 26, figs. 47, 48.

Remarks. A significant amount of variation in frequency of occurrence was detected from sample to sample of the same lithologic unit. The remarks under the genus Latipollis Krutzsch 1959 discuss the response curve generated by the frequency of occurrence of this species.

Latipollis latis Krutzsch 1959

Plate 11, Figures 29-32

1959 Latipollis latis Krutzsch, Palaeontographica, Abt. B, vol. 105, p. 130, pl. 31, figs. 13-19.

Remarks. The equatorial protuberances are longer in this species than in Latipollis normis Krutzsch 1959.

Frequency of occurrence of this species reacted in the same way as did that described for the genus. Unlike Latipollis normis Krutzsch 1959, the frequency of occurrence of this species did not vary significantly from sample to sample of the same lithologic unit.

Latipollis verrucosus Groot and Groot 1962

Plate 11, Figures 33-35

1962 Latipollis verrucosus Groot and Groot, Communications of the Geol. Survey of Portugal, vol. 46, pp. 168-169, pl. 10, figs. 1-10.

Remarks. The verrucate sculpture readily distinguish this species from others.

A highly significant amount of variation in frequency of occurrence was detected from sample to sample of the same lithologic unit. Like Latipollis normis and Latipollis latis, the frequency of occurrence of this species was controlled by changes in the linear, quadratic and cubic effects of depth as well as changes in sorting coefficient in Webb No. 1. The frequency of occurrence remained constant throughout the range of the species in Boykin No. 2. Thus, the species was not considered biostratigraphically important.

Subturma POLYTYCHES Naumova 1937

Remarks. This subturma includes all Plicates which possess more than three radially arranged colpi.

Infraturma STEPHANOCOLPITI Faegri and Iversen 1950

Remarks. Polytyches which have all of the colpi arranged equatorially are included in this infraturma.

Genus Psilastephanocolpites van Hoeken-Klinkenberg 1966

1966 Psilastephanocolpites van Hoeken-Klinkenberg, Leid. Geol. Meded., vol. 38, p. 53.

Type species: Psilastephanocolpites maia van Hoeken-Klinkenberg 1966.

Psilastephanocolpites maia van Hoeken-Klinkenberg 1966

Plate 11, Figure 36

1966 Psilastephanocolpites maia van Hoeken-Klinkenberg, Leid. Geol. Meded., vol. 38, p. 53, pl. 3, fig. 1.

Remarks. Only one specimen was recorded from the samples which were subjected to analysis. Thus, the species was not analyzed.

Unidentified Stephanocolpate Sporomorph 1

Plate 13, Figure 1

Remarks. No specimens were recovered from the samples which were subjected to analysis.

Turma COLPORATES Hart (in manuscript)

Remarks. Pollenites which possess both pores and colpi but are without sacci are included in this turma.

Subturma PTYCHOTRIPORINES Naumova 1937

Remarks. Colporates which have three radially symmetrical colpi, each of which is porate, are included in this subturma. The subturma is monotypic.

Infraturma PTYCHOTRIPORITI Naumova 1937

Remarks. The definition provided for the Subturma serves for the infraturma.

A highly significant amount of variation was detected from sample to sample of the same lithologic unit.

Frequency of occurrence was controlled by changes in depth in Webb No. 1, and by changes in depth, median grain size and sorting coefficient in Boykin No. 2. Thus, the infraturma was not considered biostratigraphically important.

Genus Tricolporopollenites Pflug 1952 ex Thomson and Pflug 1953

1952 Tricolporopollenites Pflug, Paläont. Zeit., vol. 26, p. 118.

1953 Tricolporopollenites Pflug ex Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 98.

Type species: Tricolporopollenites dolium (R. Potonié 1931) Thomson and Pflug 1953.

Remarks. The frequency of occurrence of this genus displayed a highly significant amount of variation from sample to sample of the same lithologic unit. Frequency of occurrence was controlled by changes in depth in Webb No. 1, but by changes in depth and median grain size in Boykin No. 2. Thus, the genus was not considered biostratigraphically important.

Tricolporopollenites cf. T. aliquantulus Hedlund 1966

Plate 12, Figures 1, 2

1966 Tricolporopollenites aliquantulus Hedlund, Okla. Geol. Survey, Bull. 112, p. 30, pl. 9, figs. 4a, b.

Remarks. The specimens assigned to this species differ from those described and illustrated by Hedlund

(1966) in that their equatorial outline is more triangular than the illustration of the holotype.

The prediction equation for this species includes only the quadratic effect of depth in Webb No. 1, but the cubic effect of depth, as well as the effects of changes in median grain size and sorting coefficient in Boykin No. 2.

Tricolporopollenites sp. 1

Plate 12, Figures 3-5

Remarks. This species is characterized by its small size, circular equatorial outline, and presence of a well developed margo which borders the colpi along their entire length. The margo is widest and most prominent at the equator, and progressively thins toward the poles. The pores are circular and less than 1 micron in diameter.

Although the frequency of occurrence of this species displayed a highly significant amount of variation from sample to sample of the same lithologic unit, the quadratic effect of depth as well as the effect of changes in median grain size and sorting coefficient were found to control its frequency of occurrence in Webb No. 1. In Boykin No. 2, the frequency of occurrence was controlled by changes in the linear and quadratic effects of depth and by changes in the median grain size. In both cores, the frequency of occurrence decreased with an increase in grain size. If this last point indicates an environmental significance for this species, it is

confounded with changes in sorting coefficient in Webb, and it would be difficult to separate the effects in an unknown sample.

Tricolporopollenites sp. 2

Plate 11, Figure 37

Remarks. This species is prolate in shape and the pores are elongated meridionally.

The frequency of occurrence of this species displayed a highly significant amount of variation from sample to sample of the same lithologic unit. It was controlled by changes in depth in Webb No. 1, and by changes in depth and median grain size in Boykin No. 2. The species provided no biostratigraphically important information.

Tricolporopollenites sp. 3

Plate 11, Figure 38

Remarks. The colpi are surrounded by a thick margo, and the exine is sculptured with clavae.

This species was not subjected to analysis as it was recorded from too few samples. However, it dominated the assemblage recovered from Webb No. 1 between the depths 277.2'-282.0'.

Psilatricolporites

Genus van der Hammen 1956

1956 Psilatricolporites van der Hammen, Bol. Geol. Bogata,

vol. 4, p. 91.

Type species: Psilatricolporites inornatus van der Hammen 1956.

Psilatricolporites prolatus Pierce 1961

Plate 12, Figures 6, 7

1961 Psilatricolporites prolatus Pierce, Minn. Geol. Survey, Bull. 42, p. 53, pl. 3, fig. 114.

Remarks. The frequency of occurrence of this species displayed a highly significant amount of variation from sample to sample of the same lithologic unit. Although it was controlled by changes in depth and sorting coefficient in Webb No. 1, it remained constant throughout its range in Boykin No. 2. Thus, the species was not considered in the establishment of florizones.

Genus Quercoidites R. Potonié, Thomson and Thiergart 1950

1950 Quercoidites R. Potonié, Thomson and Thiergart, Geol. Jb., vol. 65, p. 54.

Type species: Quercoidites henrici (R. Potonié 1931) R. Potonié, Thomson and Thiergart 1950.

Quercoidites ?

Plate 12, Figures 8, 9

Remarks. This sporomorph is circular in outline and possesses colpi which extend to the poles. The colpi are

bordered by a thin margo along their entire length. The colpi are characteristically concave outward in each hemisphere.

Frequency of occurrence was controlled by changes in depth in both cores. In Webb No. 1, it was controlled by changes in the quadratic effect of depth, and in Boykin No. 2, it changed with changes in the linear and quadratic effects of depth. As the response surface differed in each core, the biostratigraphic importance of the species lies in its localized range. Quercoidites?was first recorded from samples within Florizone A in both cores, and was last recorded from samples in Florizone C of both cores.

Unidentified Tricolporate Sporomorph 1

Plate 11, Figures 39, 40

Remarks. This sporomorph can be recognized by its circular shape, reticulate exine, and presence of a margo which borders the colpi along their entire length. The colpi extend nearly to the poles.

Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. In Webb No. 1, it was controlled by changes in depth alone, but in Boykin No. 2, by changes in depth and median grain size. The species was not included in any biostratigraphic considerations.

Turma POROSES Naumova 1937

Remarks. Pollenites which possess pores but no colpi or sacci are included in this turma.

Subturma TRIPORINES Naumova 1937

Remarks. Poroses with three pores are included in this subturma. The subturma is monotypic.

Infraturma TRIPORITI Naumova 1937

Remarks. The definition of the subturma serves for the definition of the infraturma.

Although the frequency of occurrence of this species displayed a highly significant amount of variation from sample to sample of the same lithologic unit, it was controlled by changes in depth in both the Webb and Boykin cores. Inasmuch as the response surface differed in each core, and it ranged throughout all samples, no biostratigraphic use was made of this infraturma.

Genus *Sporopollis* Pflug 1953

1953 *Sporopollis* Pflug, Palaeontographica, Abt. B, vol. 95, p. 96.

Type species: *Sporopollis documentum* Pflug 1953.

Remarks. This genus reacted to changes in depth in the same way as the infraturma. It ranged throughout all samples, and was not used in biostratigraphic zonation.

Sporopollis pseudosporites (Pflug in Thomson and Pflug 1953) Pflug 1953

Plate 12, Figure 10

1953 Triatriopollenites pseudosporites Pflug in Thomson and Pflug, Palaeontographica, Abt. B, vol. 94, p. 78, pl. 7, figs. 32-35.

1953 Sporopollis pseudosporites (Pflug in Thomson and Pflug) Pflug, Palaeontographica, Abt. B, vol. 95, p. 97, pl. 25, figs. 1-3.

Remarks. This species is recognized by its strongly triangular equatorial outline. The "Y-Dopple-mark" characteristic of the genus widens toward the poles and equator, and is constricted at the middle of each hemisphere.

A highly significant amount of variation in frequency of occurrence was detected from sample to sample of the same lithologic unit. However, the response surface generated in each core was controlled only by changes in depth. Inasmuch as the localized range of this species is limited, it is considered a biostratigraphically important species. No specimens were recorded from Florizone A in either core. The species ranged throughout the highest sample in Webb No. 1, but was last recorded from within Florizone C in Boykin No. 2. Thus, the biostratigraphic importance of the species is limited to its first appearance in the section.

Sporopollis sp. 1

Plate 12, Figure 11

Remarks. This sporomorph has a triangular outline as does Sporopollis pseudosporites Pflug 1953, but the pores are located on small equatorial proturberances. In addition, the "Y-Dopplemark" is constricted at the equator and widens toward the poles.

Frequency of occurrence was controlled by changes in depth in both the Webb and Boykin cores. The response surface generated contained the same effects, each with the same direction in both the Webb and Boykin cores, and biostratigraphic correlations based on changes in the frequency of occurrence of this species was attempted.

The response surface which characterizes changes in frequency of occurrence contains the linear, quadratic and cubic effects of depth. The response surface is composed of a concave portion in the upper part of both cores, and a convex portion in the lower part of each core. The point of inflection of the curves indicates the point at which the curve changes from concave to convex, and is determined by taking the second derivative of the frequency of occurrence with respect to depth, setting that derivative equal to zero, and solving for depth. The point of inflection lies within Zone B, near the border between Zones B and C in both cores. This supports the validity of the zones recognized on the basis of localized ranges.

Sporopollis sp. 2

Plate 12, Figure 12

Remarks. This sporomorph can be differentiated by its large size. The pores are located on the ends of protuberances which are longer than those displayed by Sporopollis sp. 1, and the "Y-Dopplemark" is parallel to the periphery of these protuberances.

Frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1, and by changes in depth, median grain size and sorting coefficient in Boykin No. 2. The species was not considered biostratigraphically significant.

Genus Conclavipollis Pflug 1953

1953 Conclavipollis Pflug, Palaeontographica, Abt. B, vol. 95, p. 105.

Type species: Conclavipollis anulopyramis Pflug 1953.

Conclavipollis densilatus Kimyai 1966

Plate 12, Figures 13, 14

1966 Conclavipollis densilatus Kimyai, Micropaleontology, vol. 12, no. 4, p. 471, pl. 2, fig. 15.

Remarks. This species is easily recognized by its concave sides in polar view, and the flaring nature of its pore regions.

Frequency of occurrence was controlled only by changes in depth in both the Webb and Boykin cores. The response

surface was not the same in both cores, and the biostratigraphic importance of the species lies in its localized range. The last occurrence of the species was recorded from within Florizone C in both cores.

Genus Complexiopollis Krutzsch 1959

1959 Complexiopollis Krutzsch, Palaeontographica, Abt. B, vol. 105, pp. 134-135.

Type species: Complexiopollis praetumescens Krutzsch 1959.

Remarks. Frequency of occurrence displayed a highly significant amount of variation from sample to sample of the same lithologic unit. It was controlled by changes in depth in Webb No. 1, and by changes in depth and sorting coefficient in Boykin No. 2. The genus was not considered biostratigraphically important.

Complexiopollis praetumescens Krutzsch 1959

Plate 12, Figure 15

1959 Complexiopollis praetumescens Krutzsch, Palaeontographica, Abt. B, vol. 105, pp. 135-136, pl. 31, figs. 39-54.

1965 Complexiopollis praetumescens Krutzsch. van Ameron, Pollen et Spores, vol. 7, no. 1, pp. 122-123, pl. 9, figs. 4a, b.

Remarks. This species can be differentiated from Complexiopollis sp. by its lack of verrucate sculpture.

A highly significant amount of variation in frequency of occurrence was detected from sample to sample of the same lithologic unit. In Webb No. 1, it was controlled by changes in depth, but remained constant throughout the range of the species in Boykin No. 2. No biostratigraphic importance was attached to the species.

Complexiopollis sp.

Plate 12, Figure 16

Remarks. This species has verrucate sculpture. The verrucae are 0.5 microns in height and 1 to 3 microns in length. Their width is usually less than 0.5 microns.

Frequency of occurrence was controlled by changes in depth in Webb No. 1, and remained constant throughout its range in Boykin No. 2. This species was not considered biostratigraphically important.

Genus Triorites Cookson 1950 ex Couper 1953 emend. R. Potonié 1960

1950 Triorites Cookson, Austr. Jour. Sci. Res., vol. 3, no. 2, pp. 175-176.

1953 Triorites Cookson ex Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 60.

1960 Triorites (Erdtman 1947, Cookson 1950, S. 175) ex Couper 1953 emend. R. Potonié, Beih. Geol. Jb., vol. 39, p. 128.

Type species: Triorites magnificus Cookson 1950 (designation by Couper 1953).

Triorites cf. T. edwardsii Cookson and Pike 1954

Plate 12, Figure 17

1954 Triorites edwardsii Cookson and Pike, Austr. Jour. Bot., vol. 2, no. 2, pp. 214-215, pl. 2, figs. 101-107.

Remarks. The sides of the grains reported here are not as concave as those illustrated by Cookson and Pike (1954).

Possibly because of the highly significant amount of variation displayed from sample to sample of the same lithologic unit, the frequency of occurrence remained constant throughout its range in both the Webb and Boykin cores. The species had no biostratigraphic importance.

Genus Andreisporis Belsky, Boltenhagen and R. Potonié 1965

1965 Andreisporis Belsky, Boltenhagen and R. Potonié, Palaont. Zeit., vol. 39, p. 75.

Type species: Andreisporis mariae Belsky, Boltenhagen and R. Potonié 1965.

Andreisporis cf. A. mariae

Belsky, Boltenhagen and R. Potonié 1965

Plate 12, Figure 18

1965 Andreisporis mariae Belsky, Boltenhagen and R. Potonié,

Palaont. Zeit., vol. 39, p. 75, pl. 12, figs. 4, 5.

Remarks. Belsky and Boltenhagen (1962) reported finding miospores similar to the one illustrated here from Senonian deposits of Gabon, Africa. Those grains were characterized by possessing three (rarely four) pores located at the ends of a trichotomosulcate aperture. Those forms whose pores are surrounded by a closed annulus are usually associated with a trichotomosulcate aperture which is only faintly, if at all, visible. Belsky, Boltenhagen and Potonié (1965) provided a valid name for these forms by creating the species Andreisporis mariae. Only one specimen was recorded, and the assignment to the species is tentative.

Unidentified Triporate Sporomorph 1

Plate 12, Figure 21

Remarks. This extremely small sporomorph has a morphological feature similar to a "Y-Dopplemark" which characterizes the genus Sporopollis, but too few specimens were recorded to afford a definite taxonomic identification.

Frequency of occurrence of the sporomorph was controlled by changes in depth in Boykin No. 2, but remained constant throughout its range in Webb No. 1.

Unidentified Triporate Sporomorph 2

Plate 12, Figure 19

Remarks. The pores of this specimen are located on the ends of radially positioned equatorial protrusions, and are surrounded by a strongly developed annulus.

Kuyl, Muller and Waterbolk (1955) illustrated but did not describe a form similar to the specimen illustrated here from the Tertiary of Europe.

Unidentified Polyporate (?) Sporomorph 1

Plate 12, Figure 20

Remarks. Although the specimen illustrated here exhibits four pores, only three are well-developed, suggesting it may be an abberent form of a triporate species.

Turma JUGATES Erdtman 1943

Remarks. Pollenites in which the miospores are united in groups of two, four or more individuals per unit are included in this turma.

Frequency of occurrence of this Turma was controlled by changes in depth and sorting coefficient in Webb No. 1 and by changes in depth in Boykin No. 2. No biostratigraphic importance was attached to this Turma.

Subturma DYADITES Pant 1954

Remarks. Jugates consisting of two united individuals are placed in this Subturma. The subturma is monotypic.

Infraturma DYADITI Pant 1954

Remarks. The subturma definition serves for the infraturma.

Unidentified Dyad Sporomorph 1

Plate 12, Figures 26, 27

Remarks. The individual miospores which comprise these dyads resemble miospores of Inaperturopollenites dubius (R. Potonié 1931) Thomson and Pflug 1953, but the dyads are common, and they are not considered immature forms of I. dubius. A complete taxonomic study of these sporomorphs is necessary before a positive identification can be made.

Frequency of occurrence of this sporomorph displayed a significant amount of variation from sample to sample of the same lithologic unit. It was controlled by changes in depth and sorting coefficient in Webb No. 1, and by changes in depth alone in Boykin No. 2. The species was not considered biostratigraphically important.

Subturma TETRADITES Cookson 1947

Remarks. Jugates which consist of four united individuals arranged in a tetrad formation are included in this subturma. The subturma is monotypic.

Infraturma TETRADITI Cookson 1947

Remarks. The subturma definition serves for the

infraturma.

Genus Dicotetradites Couper 1953

1953 Dicotetradites Couper, New Zealand Geol. Survey, Paleont. Bull. 22, p. 63.

Type species: Dicotetradites clavatus Couper 1953.

Dicotetradites granulatus Norton
in Norton and Hall 1969
Plate 12, Figures 22-25

1969 Dicotetradites granulatus Norton in Norton and Hall, Palaeontographica, Abt. B, vol. 125, p. 53, pl. 5, fig. 4.

Remarks. Frequency of occurrence was controlled by changes in depth in Boykin No. 2, but remained constant throughout its range in Webb No. 1. No biostratigraphic significance was attached to this species.

MIOSPORES INCERTAE SEDIS

Remarks. The miospore groups placed in this category possess apertures which were not identified as belonging to laesurae, colpi, pores, or leptoma (exinal thinnings in the distal surface of many saccate miospores).

Genus Schizosporis Cookson and Dettmann 1960

1960 Schizosporis Cookson and Dettmann, Micropaleontology, vol. 5, no. 2, p. 213.

Type species: Schizosporis reticulatus Cookson and Dettmann 1960.

Remarks. Whereas the frequency of occurrence of this genus was controlled by changes in median grain size in Webb No. 1, it remained constant throughout its range in Boykin No. 2. This genus provided no biostratigraphically important information.

Schizosporis parvus Cookson and Dettmann 1960

Plate 12, Figure 30

1960 Schizosporis parvus Cookson and Dettmann, Micropaleontology, vol. 5, no. 2, p. 216, pl. 1, figs. 15-20.

1962 Schizosporis parvus Cookson & Dettmann. Pocock, Palaeontographica, Abt. B, vol. 111, p. 76, pl. 13, figs. 200, 201.

1963 Schizosporis parvus Cookson & Dettmann. Dettmann, Roy. Soc. Victoria Proc., New Ser., vol. 77, pt. 1, p. 108, pl. 26, figs. 18, 19.

1964 Schizosporis parvus Cookson and Dettmann, 1959. Singh, Res. Council Alberta, Bull. 15, p. 101, pl. 13, fig. 15.

Remarks. This species is differentiated from Schizosporis majusculus Hedlund 1966 by its smaller size.

Frequency of occurrence was controlled by changes in depth and median grain size in Webb No. 1, but remained constant throughout its range in Boykin No. 2. No

biostratigraphic significance was attached to this species.

Schizosporis majusculus Hedlund 1966

Plate 12, Figure 31

1966 Schizosporis majusculus Hedlund, Okla. Geol. Survey, Bull. 112, p. 32, pl. 10, figs. 1a, b.

Remarks. Frequency of occurrence remained constant throughout its range in both the Webb and Boykin cores, possibly because it displayed a highly significant amount of variation from sample to sample of the same lithologic unit. The species was not considered biostratigraphically important.

Unidentified Palynomorph 1

Plate 12, Figure 29

Remarks. No aperture was observed on specimens assigned to this sporomorph, but an equatorially surrounding exinal thickening is present. Grains are characterized by an oval shape in polar (?) view.

Unidentified Palynomorph 2

Plate 12, Figure 28

Remarks. The specimens assigned to this sporomorph possess several circular openings randomly scattered about the exine. This description fits that given for the species Sporites neglectus Anderson 1960 (p. 29, pl. 4, figs. 21, 22). However, more detailed investigation must be conducted

into the morphologic features of the specimens before they can be assigned to any existing taxonomic category.

REWORKED MIOSPORES

Genus Endosporites Wilson and Coe 1940

1940 Endosporites Wilson and Coe, Amer. Midl. Natur., vol. 23, p. 184.

Type species: Endosporites ornatus Wilson and Coe 1940.

Endosporites ?

Plate 13, Figure 2

Remarks. Although the laesurae (if present) on the specimen recovered from Webb No. 1 (422.0'-427.0') is not discernible, this specimen strongly resembles the illustrations provided by Potonié (1958, pl. 4, figs. 31, 32) for the genus Endosporites. Only one specimen was recovered.

Genus Florinites Schopf, Wilson and Bentall 1944

1944 Florinites Schopf, Wilson and Bentall, Ill. Geol. Survey, Rept. Inves. no. 91, p. 58.

Type species: Florinites antiquus Schopf in Schopf, Wilson and Bentall 1944.

Florinites sp.

Plate 13, Figure 3

Remarks. The central body of this monosaccate

miospore is attached to the saccas at both poles, and has been assigned to the genus Florinites. The specimen illustrated was recovered from Webb No. 1, at a distance of 506.0'-509.0' from the surface.

Genus Triquitrites Wilson and Coe 1940
emend. R. Potonié and Kremp 1954

1940 Triquitrites Wilson and Coe, Amer. Midl. Natur., vol. 23, p. 185.

1954 Triquitrites (Wilson & Coe) R. Potonié and Kremp, Geol. Jb., vol. 69, pp. 153-154.

Type species: Triquitrites arculatus Wilson and Coe 1940.

Triquitrites sp.
Plate 13, Figure 4

Remarks. Only a portion of one specimen was recovered from Webb No. 1 (452.7'-454.8'). However, the specimen is clearly auriculate, with no exinal sculpturing.

Genus Stellisporites Alpern 1958

1958 Stellisporites Alpern, Rev. Micropal., vol. 1, no. 2, p. 78.

Type species: Stellisporites inflatus Alpern 1958.

Stellisporites sp.
Plate 13, Figure 5

Remarks. Although the specimen recovered from the

Webb core hole (330.0'-336.0') was highly carbonized, the presence of flattened, exinal extensions of the apices appear similar to those described by Alpern (1958) for the genus Stellisporites.

Genus Hamiapollenites Wilson 1962

1962 Hamiapollenites Wilson, Okla. Geol. Survey, Circ. no. 49, p. 23.

Type species: Hamiapollenites saccatus Wilson 1962.

Hamiapollenites sp.

Plate 13, Figure 6

Remarks. The disaccate, striate miospore recovered from Webb No. 1 (452.7'-454.8') is characterized by reduced sacci, striate proximal cap, and by the presence of a transverse rib on the proximal cap. Therefore, this specimen has been assigned to the genus Hamiapollenites.

Class DINOPHYCEAE Pascher

Order DINOPHYSIALES Lindemann

Family HYSTRICHODINIACEAE Deflandre

Genus Hystrichosphaeridium Deflandre 1937

emend. Eisenack 1958

1937 Hystrichosphaeridium Deflandre, Ann. Paléont., vol.

26, p. 20.

1958 Hystrichosphaeridium Deflandre emend. Eisenack, Neues Jb. Geol. Palaeont., vol. 106, p. 399.

Type species: Hystrichosphaeridium tubiferum (Ehrenberg 1938) Deflandre 1937.

Remarks. Frequency of occurrence was controlled by changes in depth in Webb No. 1, and by changes in depth and median grain size in Boykin No. 2. It was not considered biostratigraphically important.

Hystrichosphaeridium tubiferum (Ehrenberg 1838) Deflandre 1937

Plate 14, Figure 2

1838 Xanthidium tubiferum Ehrenberg, Abh. K. Akad. Wiss., Berlin, pl. 1, fig. 16.

1933 Hystrichosphaera tubifera O. Wetzel, Palaeontographica, Abt. B, vol. 78, p. 40, pl. IV, fig. 16.

1937 Hystrichosphaeridium tubiferum (Ehrb.) Deflandre, Ann. Paléont., vol. 26, p. 21.

1939 Hystrichosphaeridium tubiferum Deflandre. Lejeune-Carpentier, Ann. Soc. Geol. Belgique, vol. 63, p. 218.

1958 Hystrichosphaeridium tubiferum Deflandre. Eisenack, Neues Jb. Geol. Palaeont., vol. 106, p. 401.

1965 Hystrichosphaeridium tubiferum (Ehrb.) Deflandre. Stanley, Bull. Amer. Paleont., vol. 49, no. 222, p. 232, pl. 25, figs. 7-12.

Remarks. Frequency of occurrence was controlled by changes in median grain size in both the Webb and Boykin cores. In Webb No. 1, the change was also effected by depth. The species was not considered biostratigraphically important.

Hystrichosphaeridium truncigerum Deflandre 1937

Plate 14, Figure 11

1937 Hystrichosphaeridium truncigerum Deflandre, Ann. Paléont., vol. 26, pp. 71-72, pl. 13, figs. 6, 7.

Remarks. Specimens were recorded from too few samples to permit analysis.

Hystrichosphaeridium xanthiopyxides (O. Wetzel 1933) Deflandre 1937

Plate 13, Figure 10

1933 Hystrichosphaera xanthiopyxides O. Wetzel, Palaeontographica, Abt. B, vol. 78, pp. 44-45, pl. 4, fig. 25.

1937 Hystrichosphaeridium xanthiopyxides (O. Wetzel) Deflandre, Ann. Paléont., vol. 26, p. 77.

Remarks. This species possesses stout processes which allow easy recognition.

Hystrichosphaeridium pulcherrium Deflandre and Cookson 1955

Plate 14, Figure 1

1955 Hystrichosphaeridium pulcherrium Deflandre and Cookson, Austr. Jour. Marine and Freshwater Res., vol. 6,

pp. 270-271, pl. 1, fig. 8.

Remarks. The large size of this species allows easy recognition.

Only three specimens were recovered during the investigation.

Hystrichosphaeridium sp.

Plate 14, Figure 4

Remarks. The thin processes characteristic of the dinophyceae are often bi- or trifurcate at their distal ends.

Although the frequency of occurrence was controlled by changes in depth in both the Webb and Boykin cores, the form extended throughout the range of samples, and could not be used in establishing biostratigraphic zones.

Family Affiliation Uncertain

Genus Spinidinium Cookson and Eisenack 1962

1962 Spinidinium Cookson and Eisenack, Micropaleontology, vol. 8, no. 4, p. 489.

Type species: Spinidinium styloniferum Cookson and Eisenack 1962.

Spinidinium sp.

Plate 13, Figure 7

Remarks. No specimens were recorded within the limits

of the data collect for purposes of analysis.

Unidentified Dinophyceae Cyst 1

Plate 13, Figure 8

Remarks. Frequency of occurrence was controlled by changes in depth in both cores. The limited vertical range of this dinophyceae may be useful in biostratigraphic correlation. Its first occurrence is in samples within Florizone A in both cores, and its last appearance in samples within Florizone C in both cores. However, this might reflect similarities in marine conditions, and the species was not used in establishing the florizones.

Group ACRITARCHA Evitt 1963

Subgroup ACANTHOMORPHITAE Downie, Evitt and Sarjeant 1963

Genus Micrhystridium Deflandre 1937 emend. Downie and Sarjeant 1963

1937 Micrhystridium Deflandre, Ann. Paléont., vol. 26, p. 79.

1961 Micrhystridium Deflandre emend. Staplin, Palaeont., vol. 4, pt. 3, p. 408.

1963 Micrhystridium Deflandre emend. Downie and Sarjeant, Palaeont., vol. 6, no. 1, p. 92.

Type species: Micrhystridium inconspicuum (Deflandre 1937) Deflandre 1947.

Remarks. Although the frequency of occurrence of this genus was controlled by changes in depth in both cores, this changes was confounded with changes in median grain size in Boykin No. 2. In addition, it varied significantly from sample to sample of the same lithologic unit. Thus, it was not considered biostratigraphically important.

Micrhystridium fragile Deflandre 1947

Plate 14, Figures 6, 7

1947 Micrhystridium fragile Deflandre, Bull. de l'Institut Oceanographique, no. 921, p. 8, figs. 13-18.

1966 Micrhystridium fragile Deflandre. Sarjeant, Rev. Micropal., vol. 9, no. 1, pl. 1, fig. 7, text-fig. 1-H.

Remarks. This species was not considered biostratigraphically important, as its frequency of occurrence was controlled by changes in depth and sorting coefficient in Webb No. 1, but only by changes in depth in Boykin No. 2.

Micrhystridium piliferum Deflandre 1937

Plate 13, Figures 11, 12

1937 Micrhystridium piliferum Deflandre, Ann. Paléont., vol. 26, pp. 80-81, pl. 15, fig. 11.

1965 Micrhystridium piliferum Deflandre, 1937. Stanley, Bull. Amer. Paleont., vol. 49, no. 222, p. 233, pl. 23, figs. 3-5.

Remarks. Frequency of occurrence was controlled by changes in sorting coefficient in Webb, but by changes in depth and median grain size in Boykin. The species is not biostratigraphically important.

Micrhystridium sp.

Plate 14, Figures 9, 10

Remarks. This acritarch resembles forms described by Wall (1965) as Micrhystridium wattonensis from the Lias of England and South Wales. The forms recovered from the Alabama samples differ from those described by Wall by having fewer spines which are not capitate.

No biostratigraphic importance was attached to this acritarch because its frequency of occurrence was controlled by changes in depth and median grain size in Webb No. 1 but only by depth in Boykin No. 2.

Genus Baltisphaeridium Eisenack 1958
emend. Downie and Sarjeant 1963

1958 Baltisphaeridium Eisenack, Neues. Jb. Geol. Palaont., vol. 106, p. 398.

1963 Baltisphaeridium Eisenack emend. Downie and Sarjeant, Stanf. Univ. Publ., Geol. Sci., vol. 7, no. 3, p. 89.

Type species: Baltisphaeridium hispidum (Eisenack 1931) Eisenack 1958.

Baltisphaeridium sp.

Plate 14, Figure 3

Remarks. This acritarch is differentiated from Micrhystridium piliferum Deflandre 1937 only on the basis of its larger size. Both acritarchs have numerous hair-like spines evenly distributed over the cyst.

Frequency of occurrence was controlled by changes in depth in both cores, but in Boykin No. 2, changes in median grain size also effected the frequency of occurrence.

Subgroup PTEROMORPHITAE Downie, Evitt and Sarjeant 1963

Genus Pterospermopsis W. Wetzel 1952

1952 Pterospermopsis W. Wetzel, Geol. Jb., vol. 66, p. 411.

Type species: Pterospermopsis danica W. Wetzel 1952.

Pterospermopsis sp.

Plate 14, Figure 5

Remarks. Specimens assigned to this acritarch were recovered from only one sample (Boykin No. 2, 307.0'-310.5'), therefore, no analyses were performed on the frequency of occurrence.

Subgroup NETROMORPHITAE Downie, Evitt and Sarjeant 1963

Genus Metaleiofusa Wall 1965

1965 Metaleiofusa Wall, Micropaleontology, vol. 11,

no. 2, p. 161.

Type species: Metaleiofusa arcuata Wall 1965.

Metaleiofusa diagonalis Wall 1965

Plate 13, Figure 13

1965 Metaleiofusa diagonalis Wall, Micropaleontology, vol. 11, no. 2, pp. 161-162, pl. 5, figs. 21-23; pl. 9, fig. 3.

Remarks. Although the frequency of occurrence of this species was controlled by changes in depth in Webb No. 1, it remained constant throughout its range in Boykin No. 2, and was not considered biostratigraphically important.

Unidentified Acritarch 1

Plate 13, Figure 9

Remarks. Frequency of occurrence of this acritarch was controlled by changes in depth in both the Webb and Boykin cores, but was confounded with changes in median grain size in Boykin No. 2. It was not considered biostratigraphically important.

Unidentified Acritarch 2

Plate 14, Figure 8

Remarks. The small size and simple, conical spines of this suggest it belongs to Micrhystridium, but further investigation is necessary before a definite taxonomic

placement can be made.

This acritarch displayed a frequency of occurrence controlled by changes in depth in Boykin No. 2, and by changes in depth and sorting coefficient in Webb No. 1. No biostratigraphic importance was attached to the species.

Unidentified Acritarch 3

Plate 14, Figure 12

Remarks. No complete specimens were recovered during the course of this investigation. However, the short, bi- and trifurcate processes allow easy recognition of the acritarch.

Inasmuch as frequency of occurrence displayed a significant amount of variation with changes in depth in both cores, it may prove to be a biostratigraphically important acritarch. The localized range of this acritarch extends throughout Florizone B, and into Florizone C.

APPENDIX B

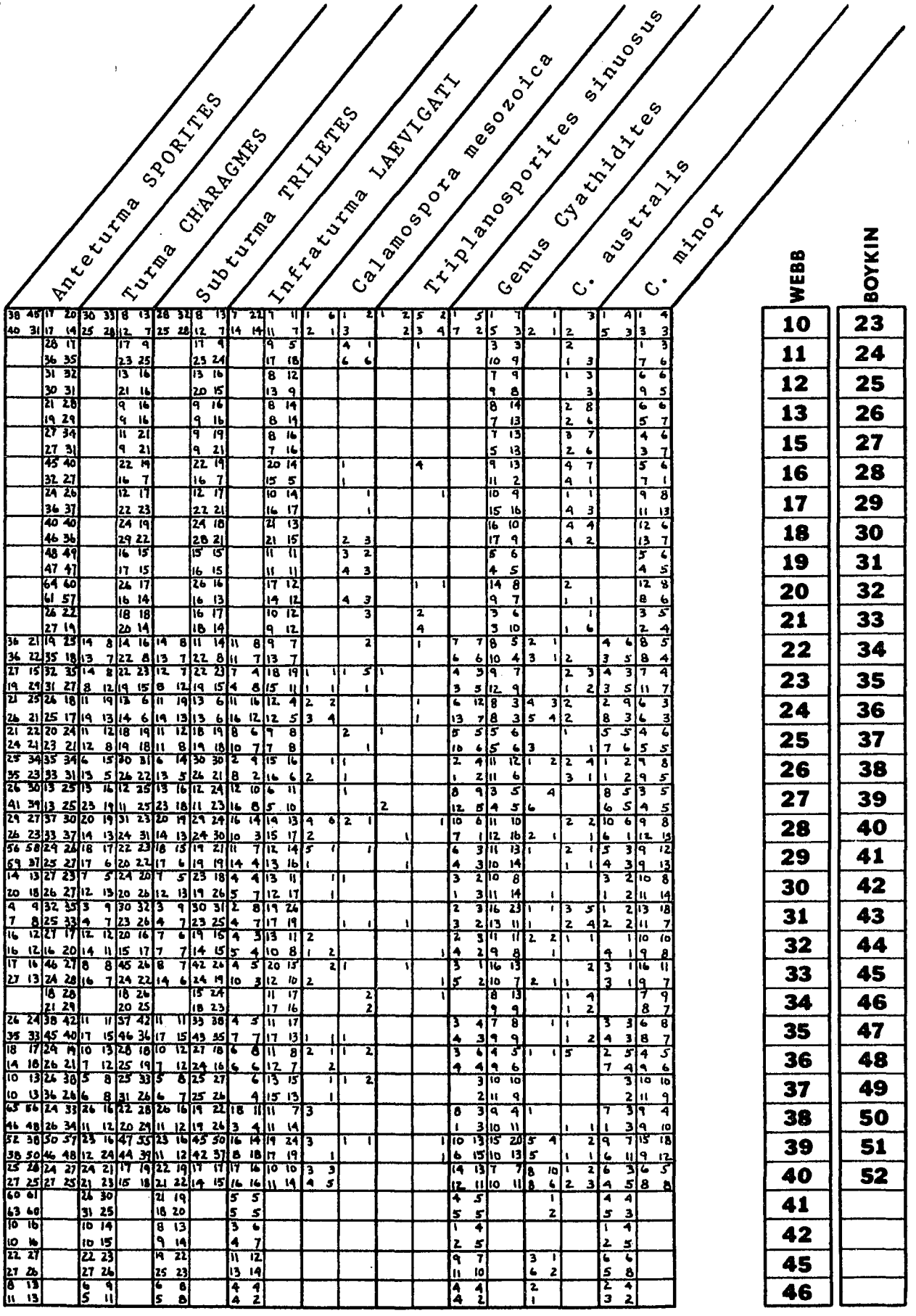
FREQUENCY COUNTS

An estimate of the relative abundance of each taxon, out of a total count of 150 palynomorph grains per slide in each lithologic unit, was based on counts obtained from four slides, as two slides were examined for two samples taken from the same lithologic unit. These data are presented in this Appendix.

The frequency counts for a given taxon in both the Webb and Boykin cores are presented together, under the heading for that taxon. Frequency counts obtained from the Webb core are presented in the first column, and those for the Boykin core in the second column. Lithologic units are identified by the sample numbers which appear in the extreme right-hand columns. These sample numbers correspond to those presented in Tables VII and VIII. The depth of each lithologic unit, its median grain size and sorting coefficient are also presented in these tables.

The four estimates of the relative abundance of a given taxon in a given core were recorded as follows: the frequency counts made on the slides from the first sample are represented by the numbers in the upper half of the box, and the numbers in the lower half represent the frequency counts made on the slides from the second sample. Blank spaces indicate a frequency count of zero.

Only those lithologic units between the first and last palynomorph-yielding lithologic units are included in the Appendix.


Anteturma SPORITES
Turma CHARAGMES
Subturma TRILETES
Infraturma LAEVIGATI
Calamospora mesozoica
Triplanosporites sinuosus
Genus Cyathidites
C. australis
C. minor
WEBB
BOYKIN
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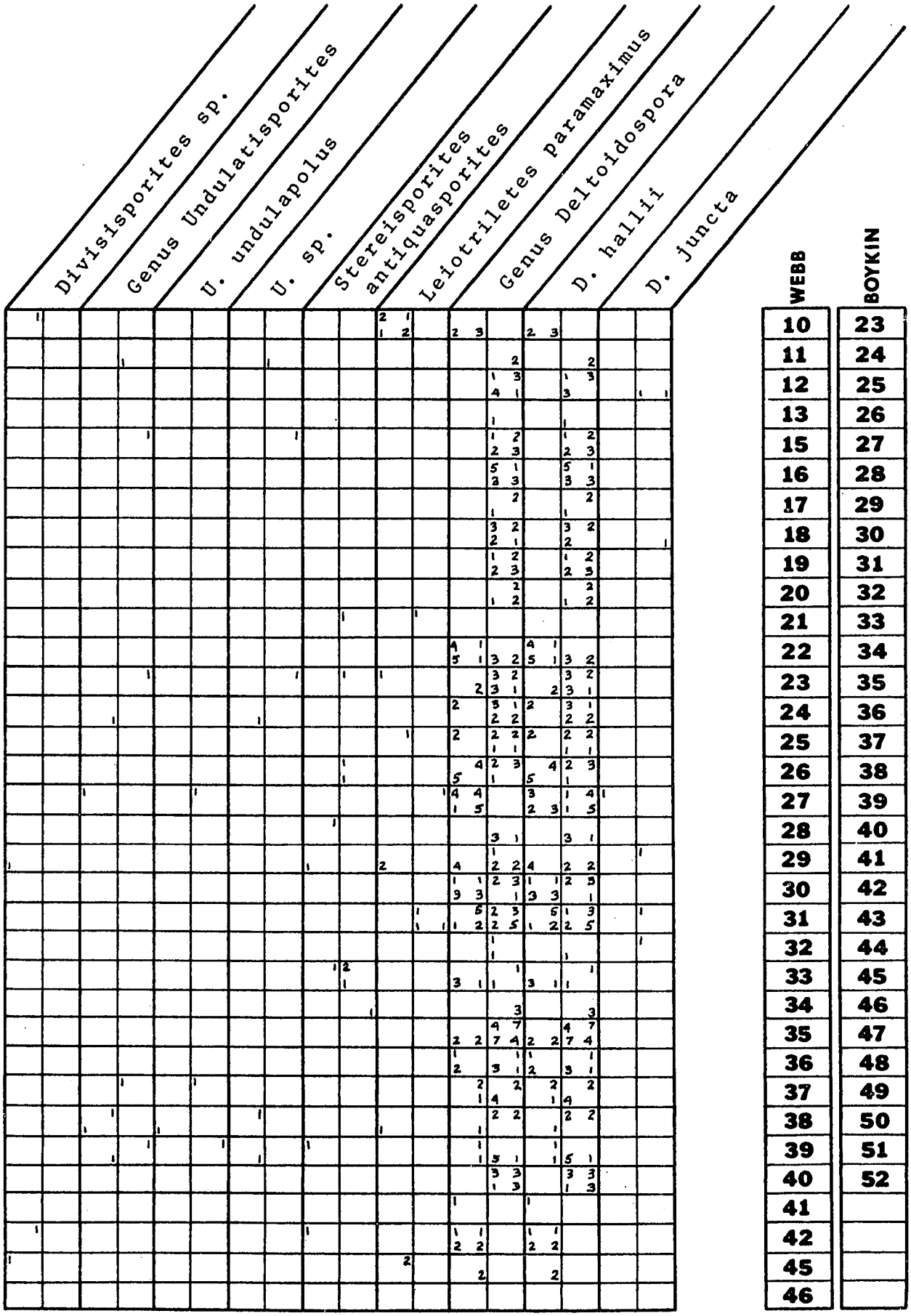
Divisisporites sp.
Genus Undulatisporites
U. undulapolus
U. sp.
Stereisporites antiquasporites
Leiotriletes paramaximus
Genus Deltoidospora
D. hallii
D. juncta
WEBB
BOYKIN
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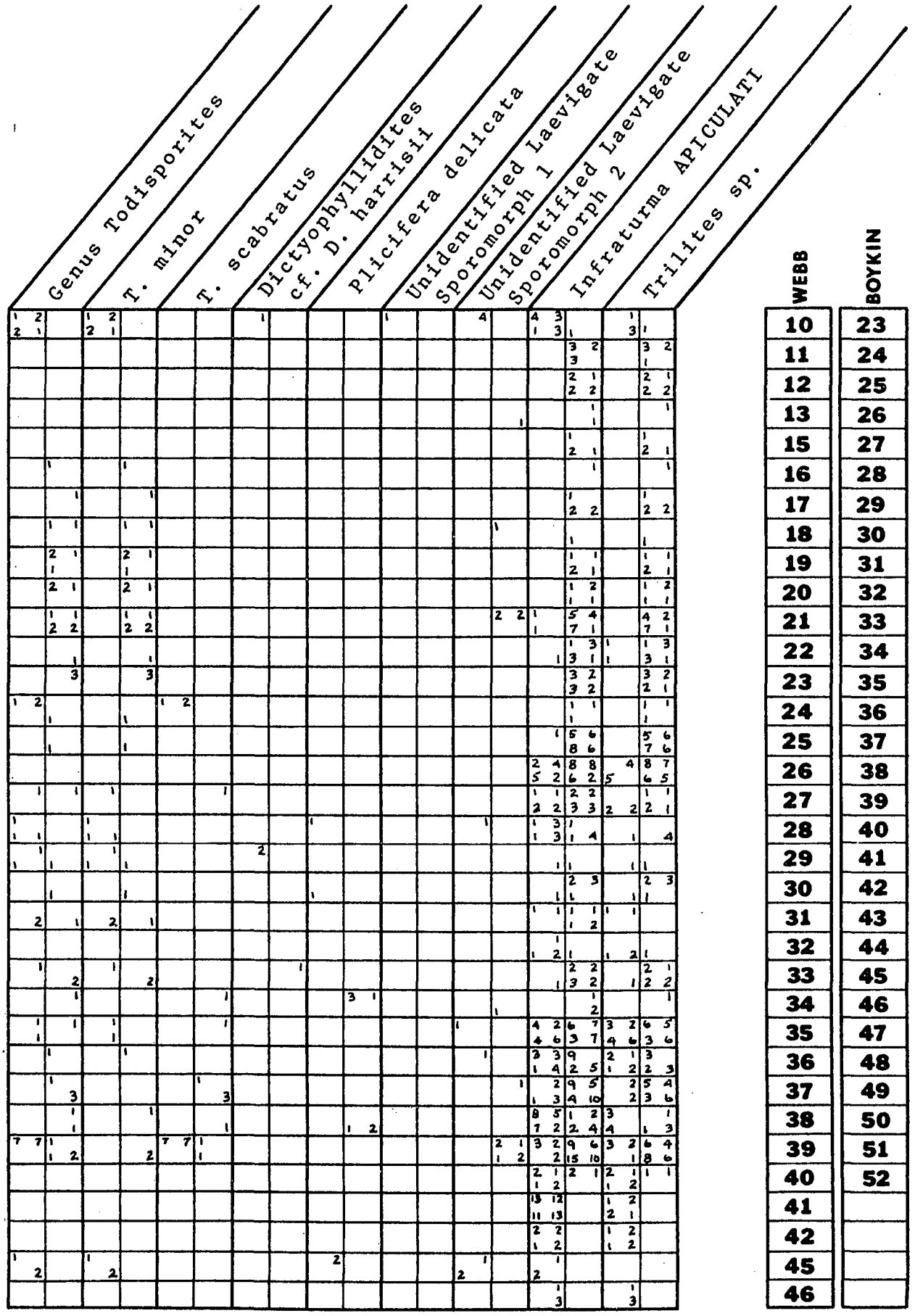
Genus Todisporites
T. minor
T. scabratus
Dictyophyllidites cf. D. harrisii
Plicifera delicata
Unidentified Laevigate Sporomorph 1
Unidentified Laevigate Sporomorph 2
Infraturma APICULATI
Trilites sp.
WEBB
BOYKIN
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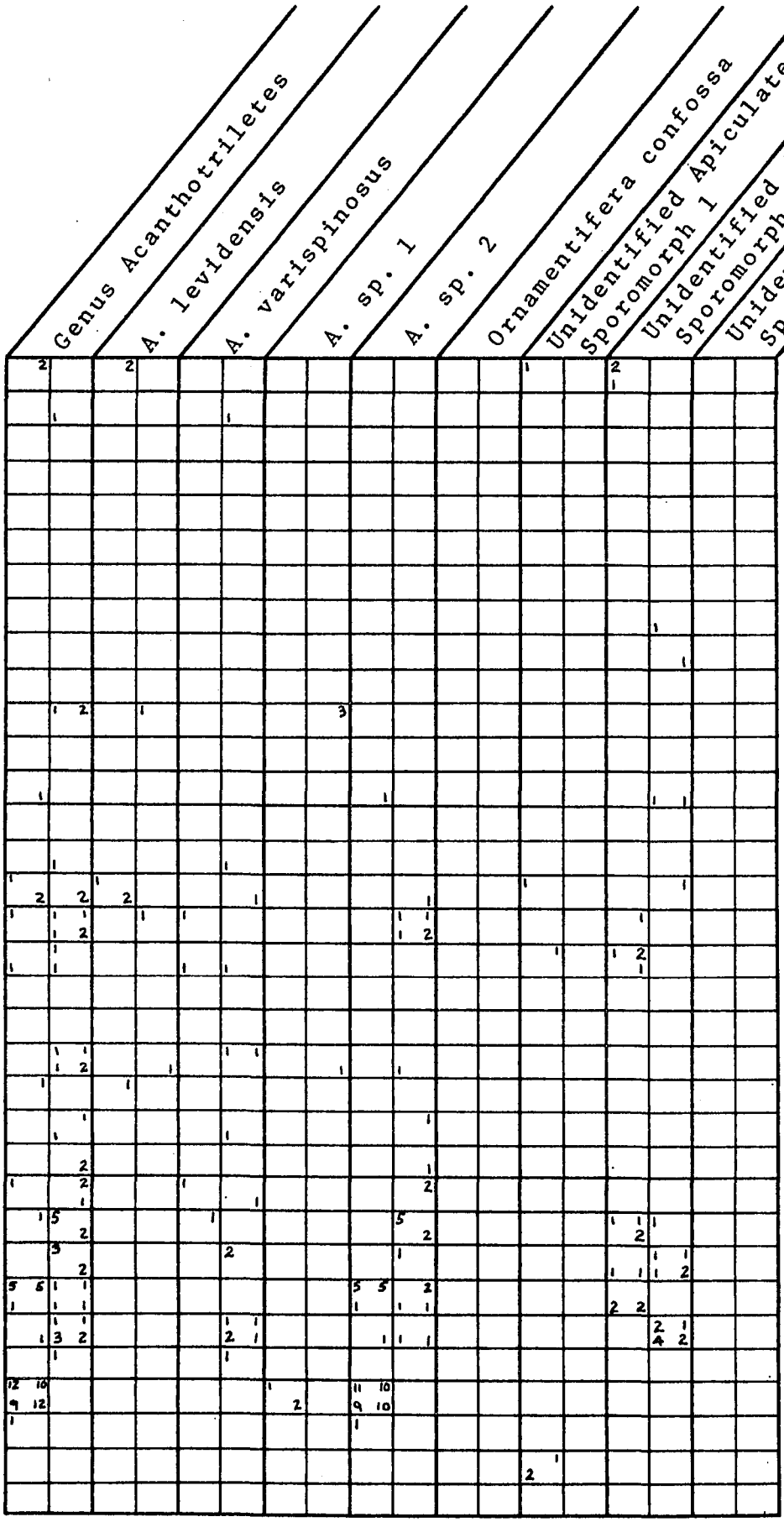

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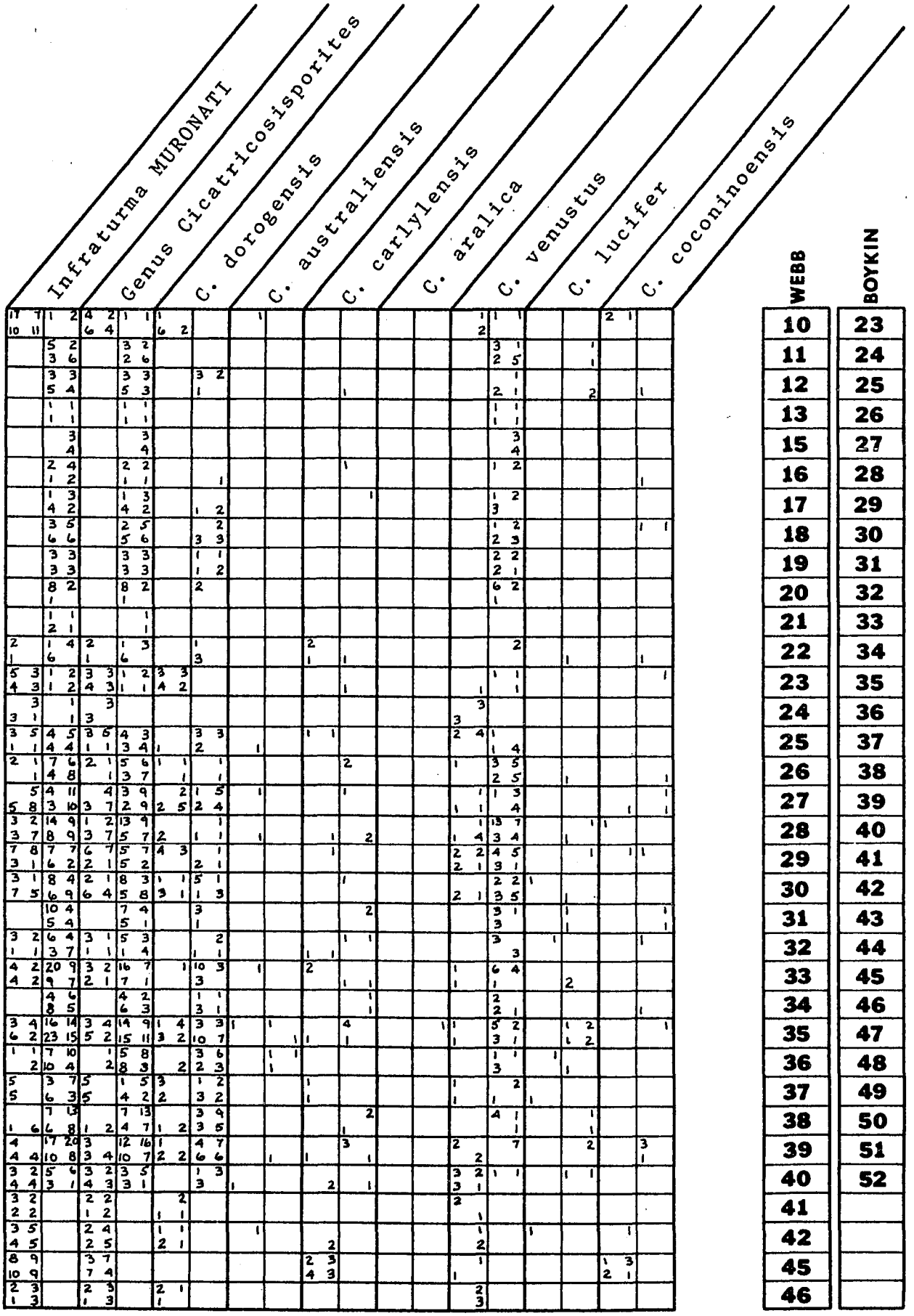
Infraturma MURONATI
Genus Cicatricosisporites
C. dorogensis
C. australiensis
C. carlylensis
C. aralica
C. venustus
C. lucifer
C. coconinoensis
WEBB
BOYKIN
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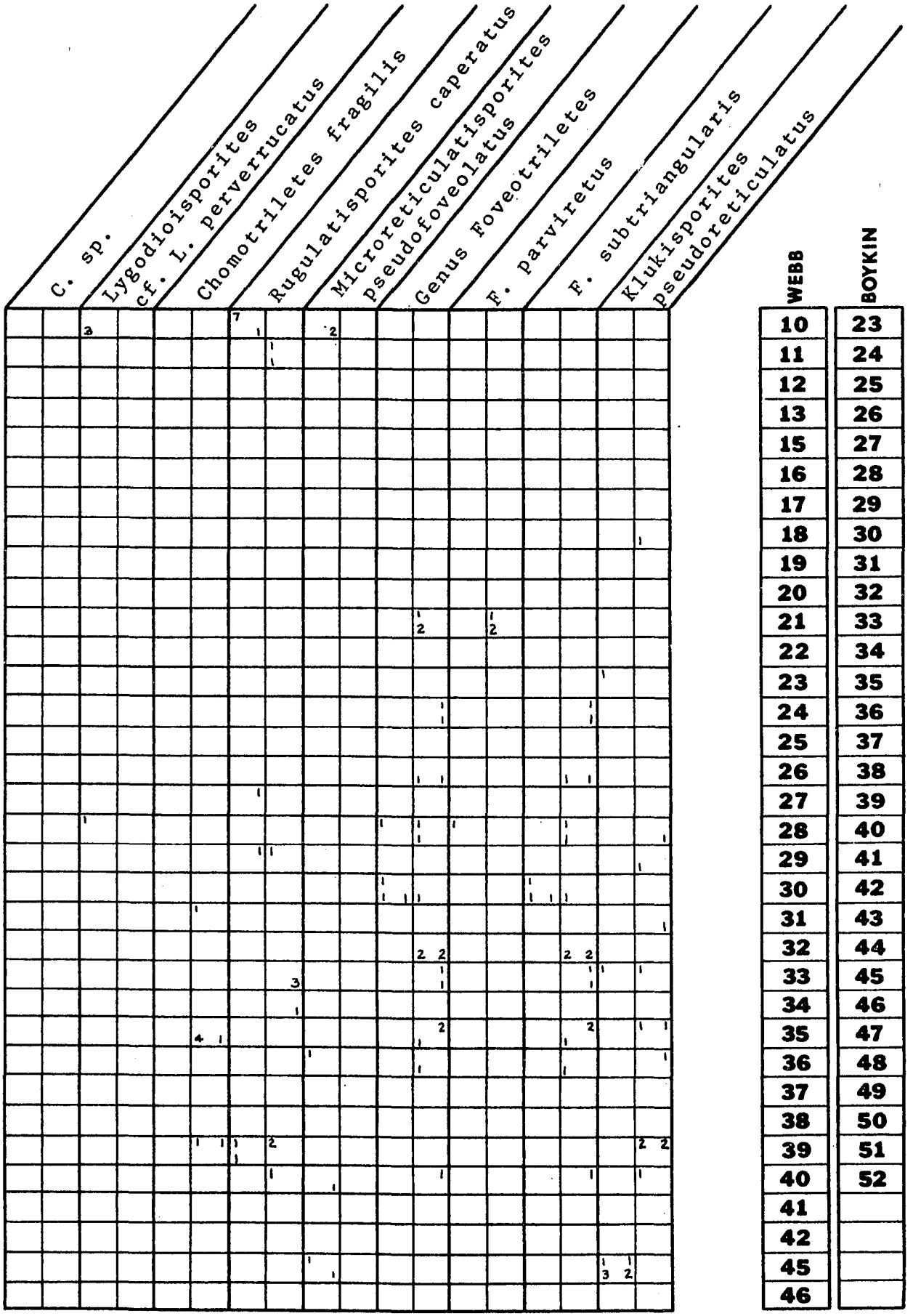
C. sp.
Lygodioisporites cf. L. perverrucatus
Chomotriletes fragilis
Rugulatisporites caperatus
Microreticulatisporites pseudofoveolatus
Genus Foveotriletes
F. parviretus
F. subtriangularis
Klukisporites pseudoreticulatus
WEBB
BOYKIN
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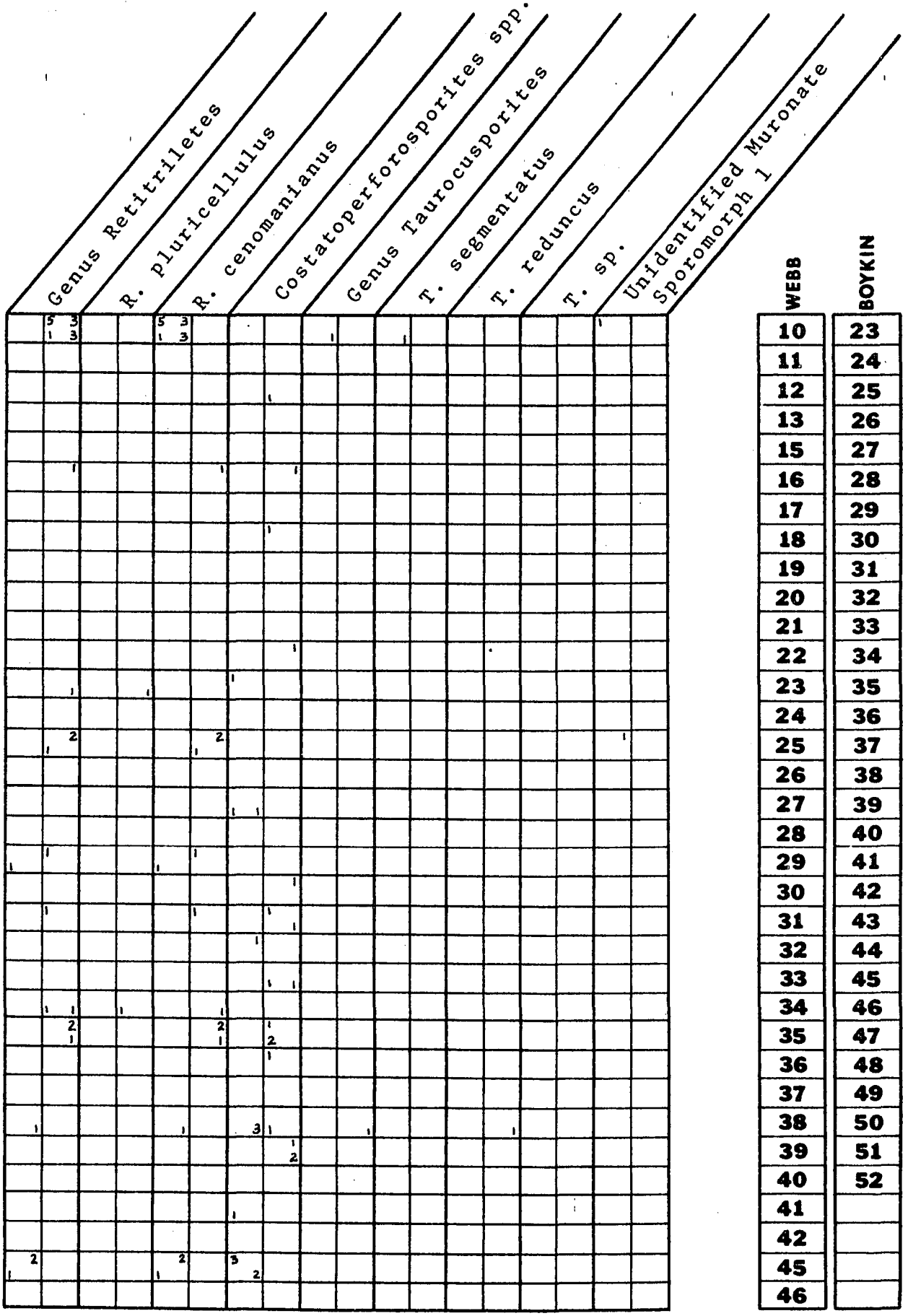
Genus Retitriletes
R. pluricellulus
R. cenomanianus
Costatoperforosporites spp.
Genus Taurocusporites
T. segmentatus
T. reduncus
T. sp.
Unidentified Muronate Sporomorph 1
WEBB
BOYKIN
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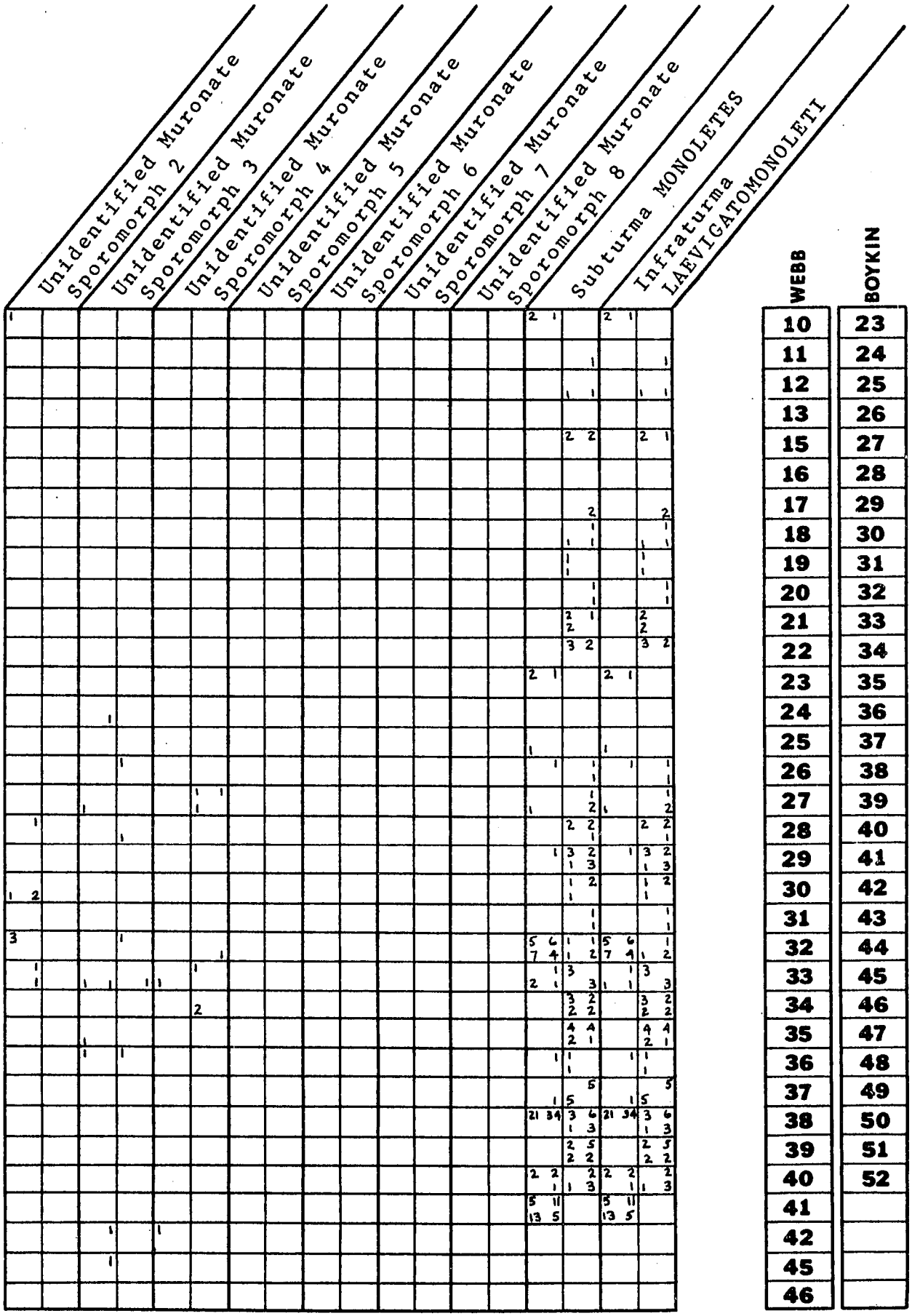
Unidentified Muronate Sporomorph 2
Unidentified Muronate Sporomorph 3
Unidentified Muronate Sporomorph 4
Unidentified Muronate Sporomorph 5
Unidentified Muronate Sporomorph 6
Unidentified Muronate Sporomorph 7
Unidentified Muronate Sporomorph 8
Subturma MONOLETES
Infraturma LAEVIGATOMONOLETI
WEBB
BOYKIN
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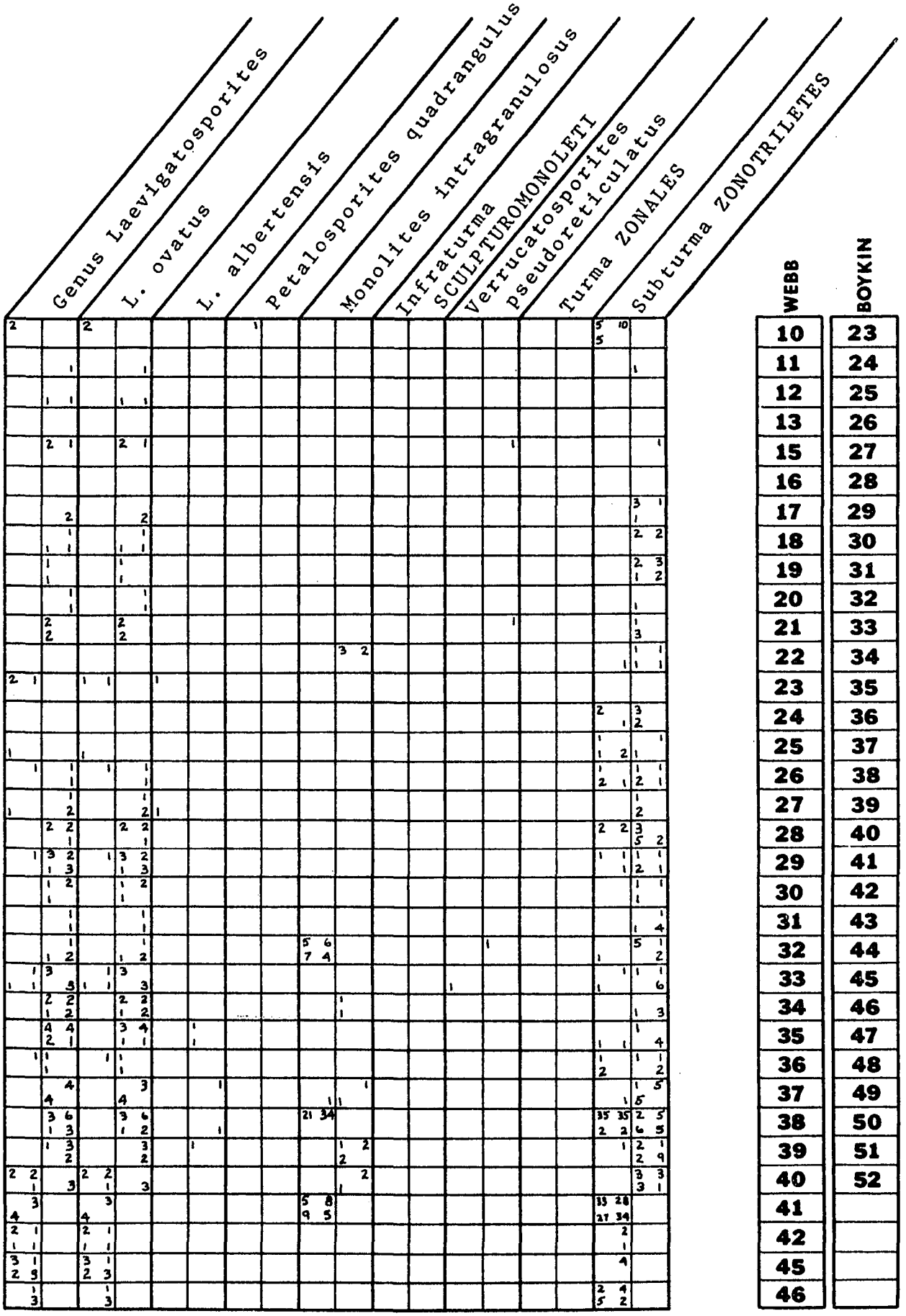
Genus Laevigatosporites
L. ovatus
L. albertensis
Petalosporites quadrangulus
Monolites intragranulosus
Infraturma SCULPTUROMONOLETI
Verrucatosporites pseudoreticulatus
Turma ZONALES
Subturma ZONOTRILETES
WEBB
BOYKIN
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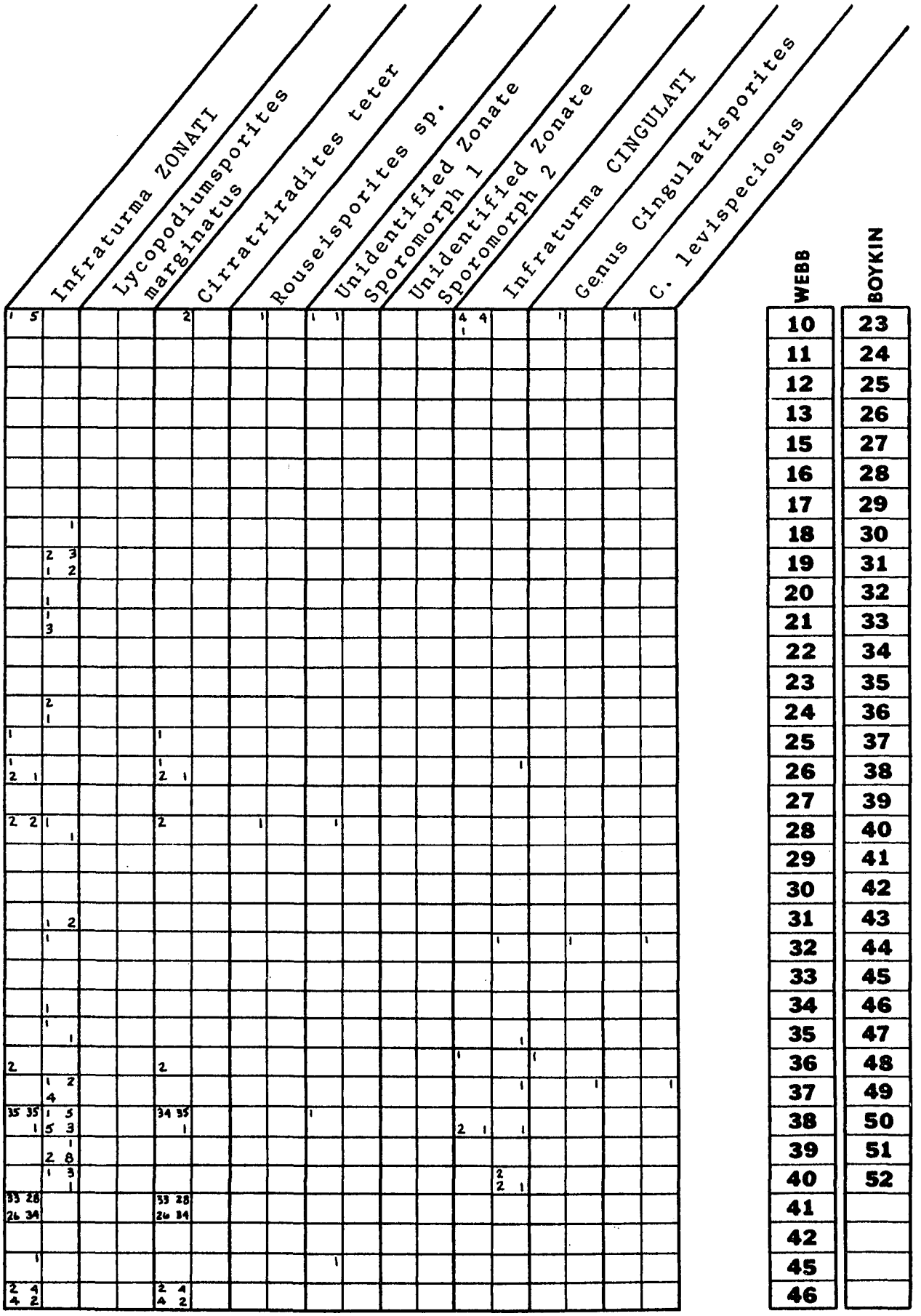
Infraturma ZONATI
Lycopodiumsporites marginatus
Cirratriradites teter
Rouseisporites sp.
Unidentified Zonate Sporomorph 1
Unidentified Zonate Sporomorph 2
Infraturma CINGULATI
Genus Cingulatisporites
C. levispeciosus
WEBB
BOYKIN
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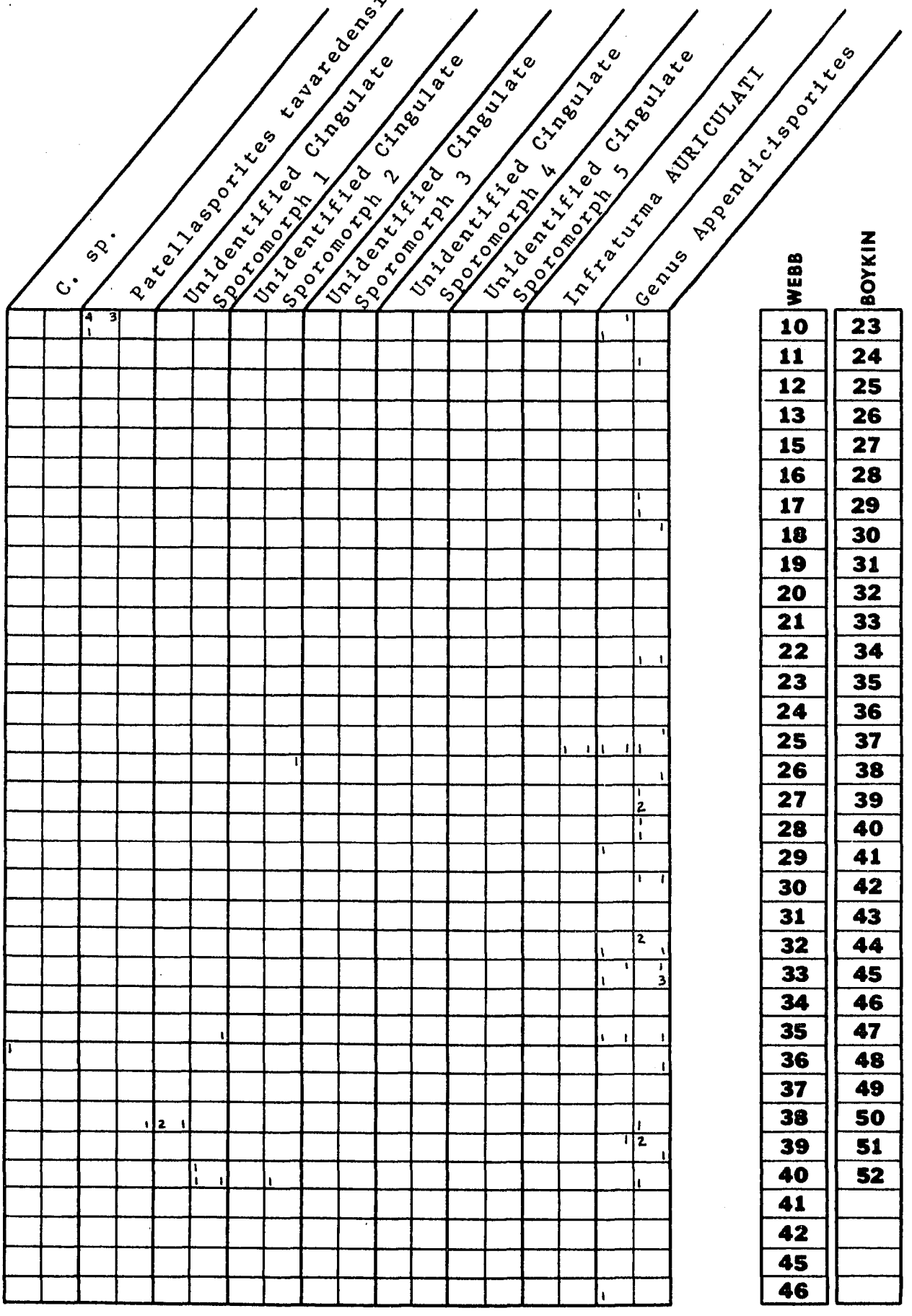
C. sp.
Patellasporites tavaredensis
Unidentified Cingulate Sporomorph 1
Unidentified Cingulate Sporomorph 2
Unidentified Cingulate Sporomorph 3
Unidentified Cingulate Sporomorph 4
Unidentified Cingulate Sporomorph 5
Infraturma AURICULATI
Genus Appendicisporites
WEBB
BOYKIN
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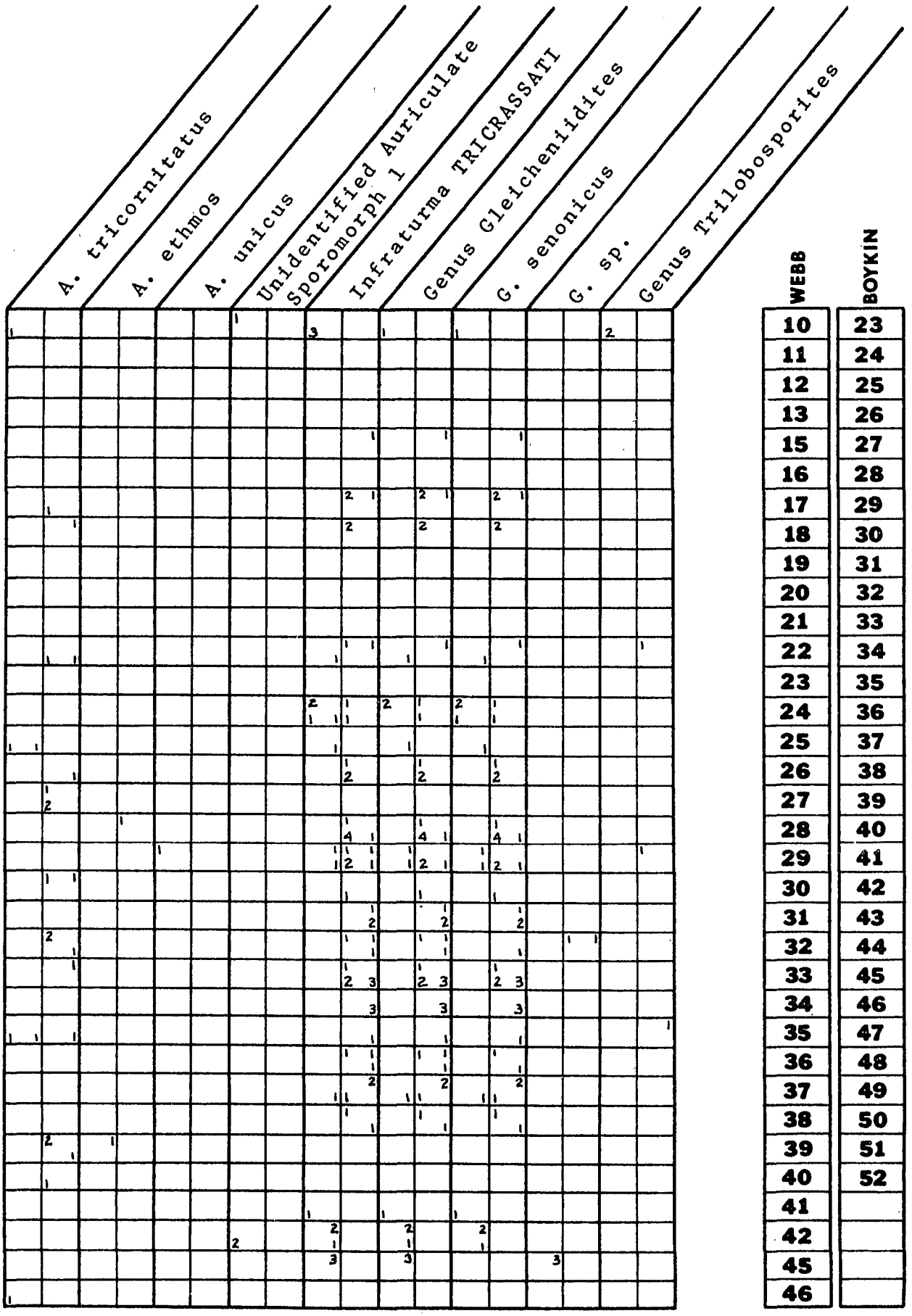
A. tricornitatus
A. ethmos
A. unicus
Unidentified Auriculate Sporomorph 1
Infraturma TRICRASSATI
Genus Gleichenidites
G. senonicus
G. sp.
Genus Trilobosporites
WEBB
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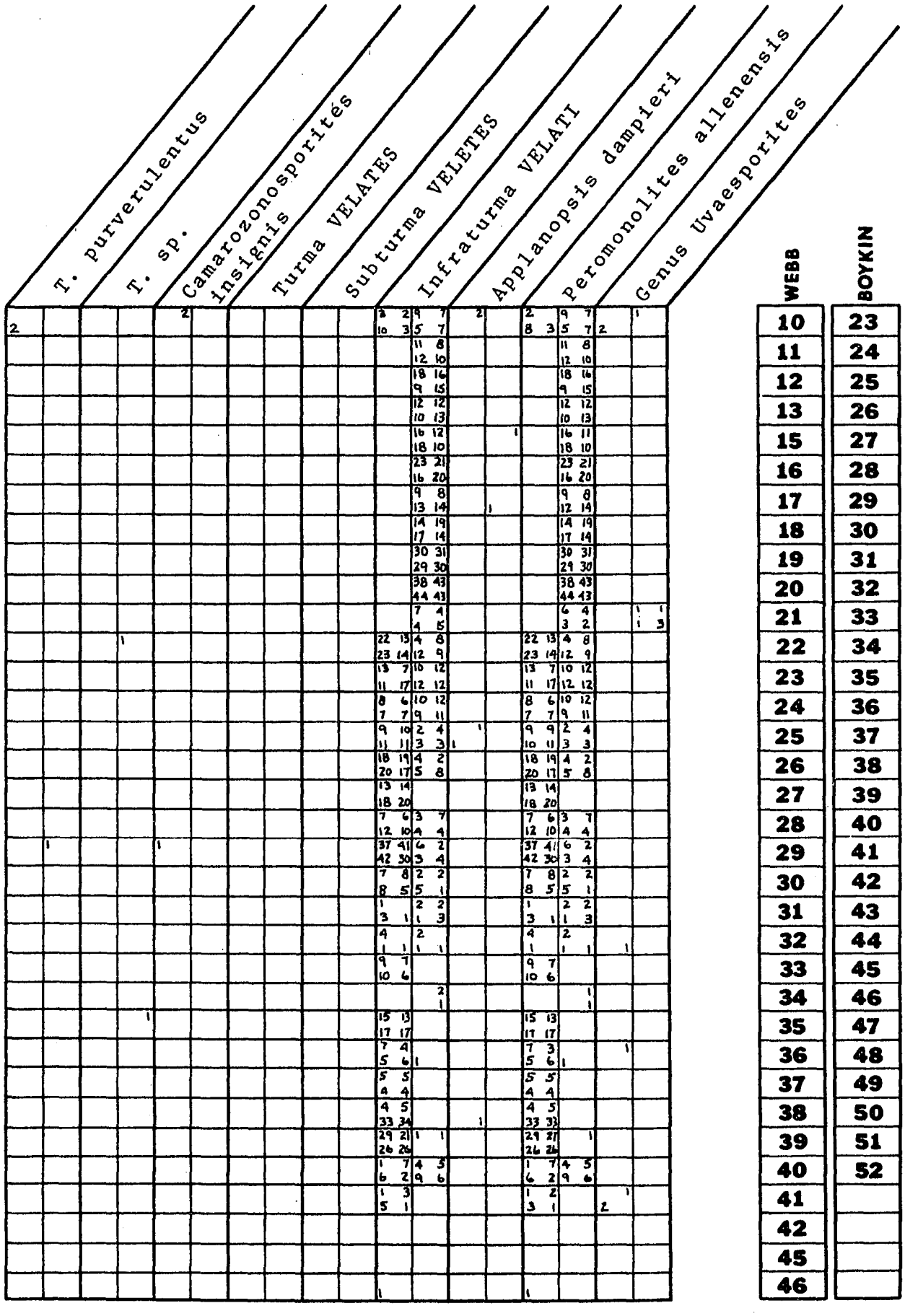
T. purverulentus
T. sp.
Camarozonosporites insignis
Turma VELATES
Subturma VELETES
Infraturma VELATI
Applanopsis dampieri
Peromonolites allenensis
Genus Uvaesporites
WEBB
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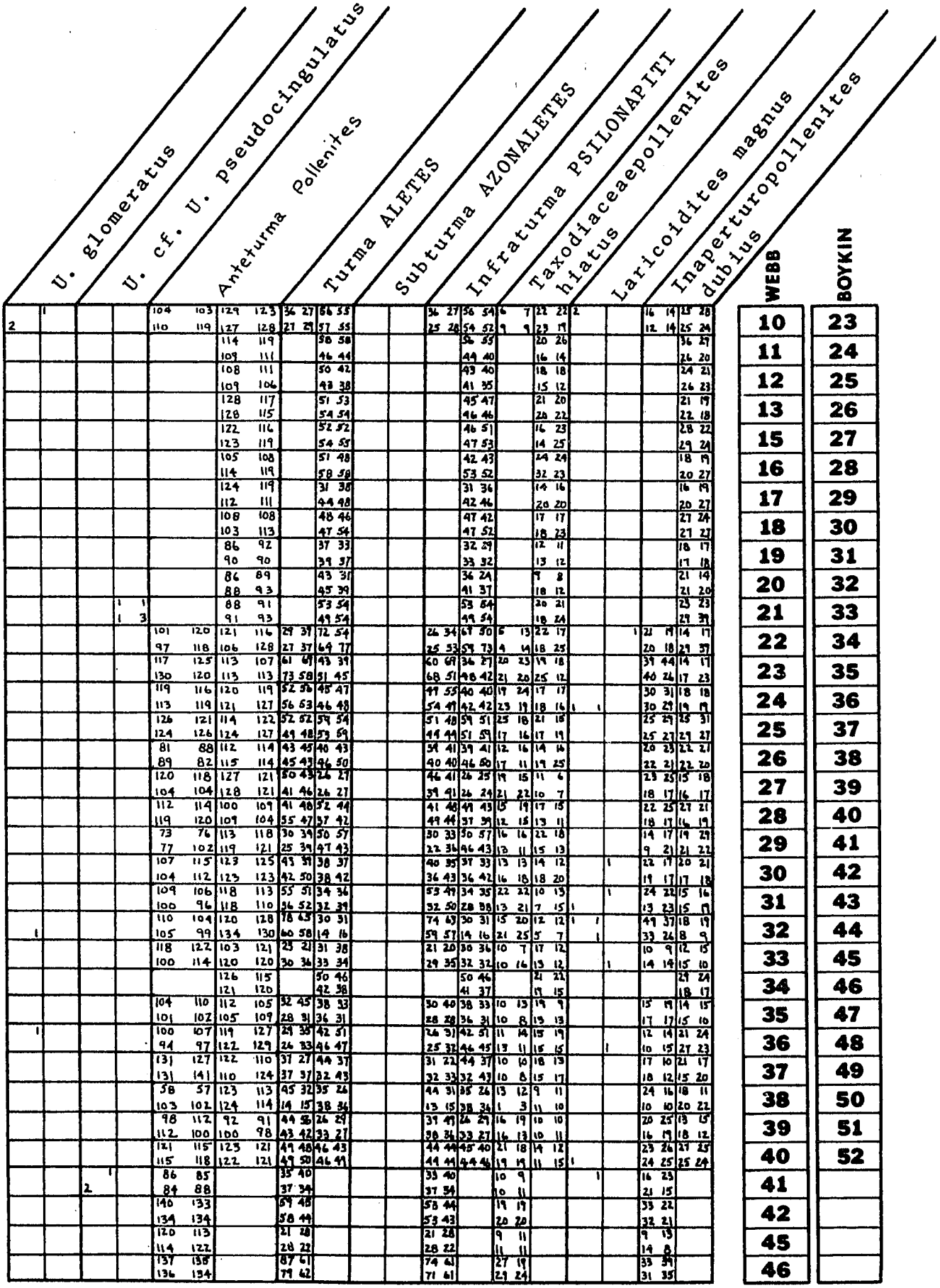
U. glomeratus
U. cf. U. pseudocingulatus
Anteturma Pollenites
Turma ALETES
Subturma AZONALETES
Infraturma PSILONAPITI
Taxodiaceaepollenites hiatus
Laricoidites magnus
Inaperturopollenites dubius
WEBB
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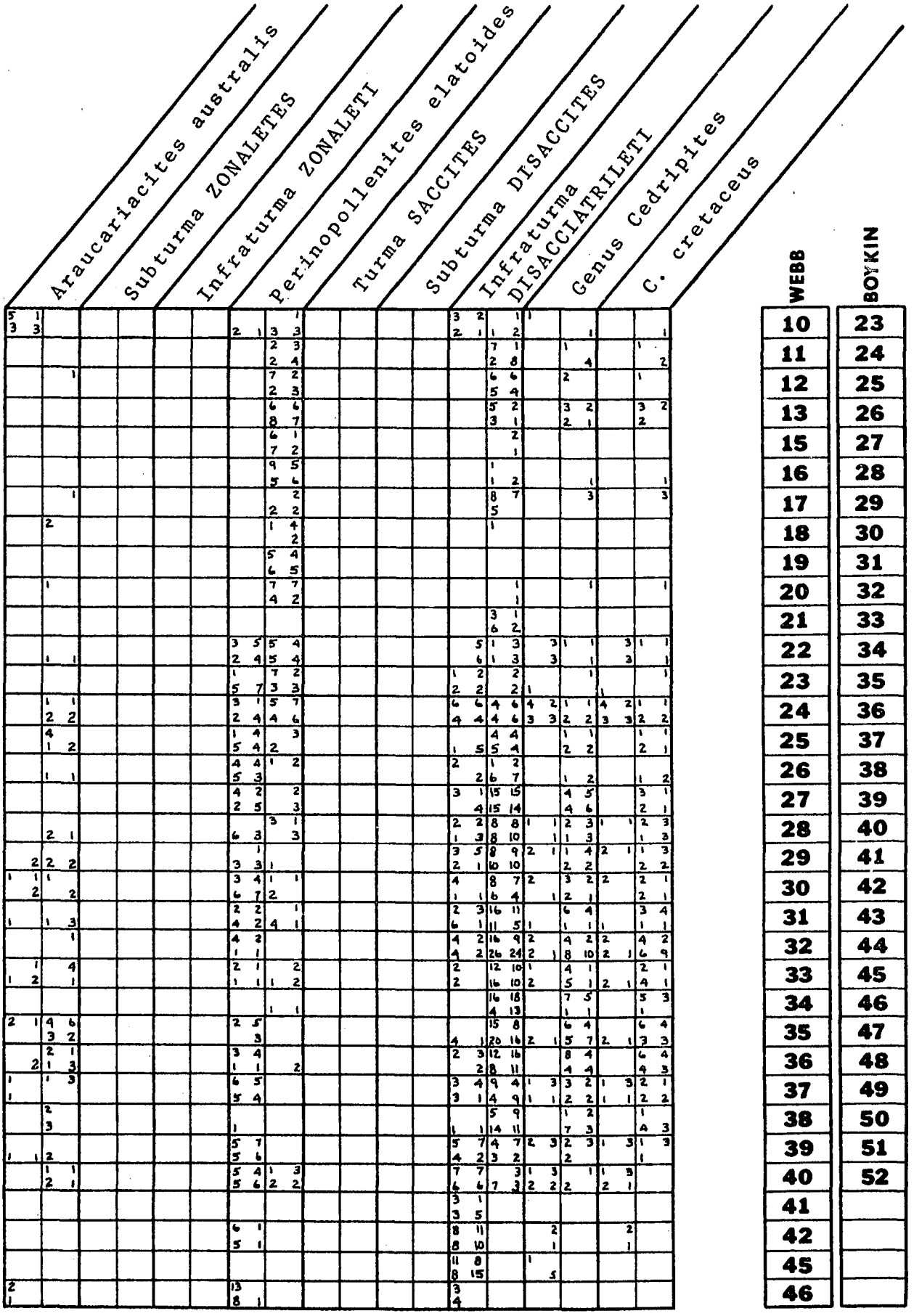
Araucariacites australis
Subturma ZONALETES
Infraturma ZONALETI
Perinopollenites elatoides
Turma SACCITES
Subturma DISACCITES
Infraturma DISACCIATRILETI
Genus Cedripites
C. cretaceus
WEBB
BOYKIN
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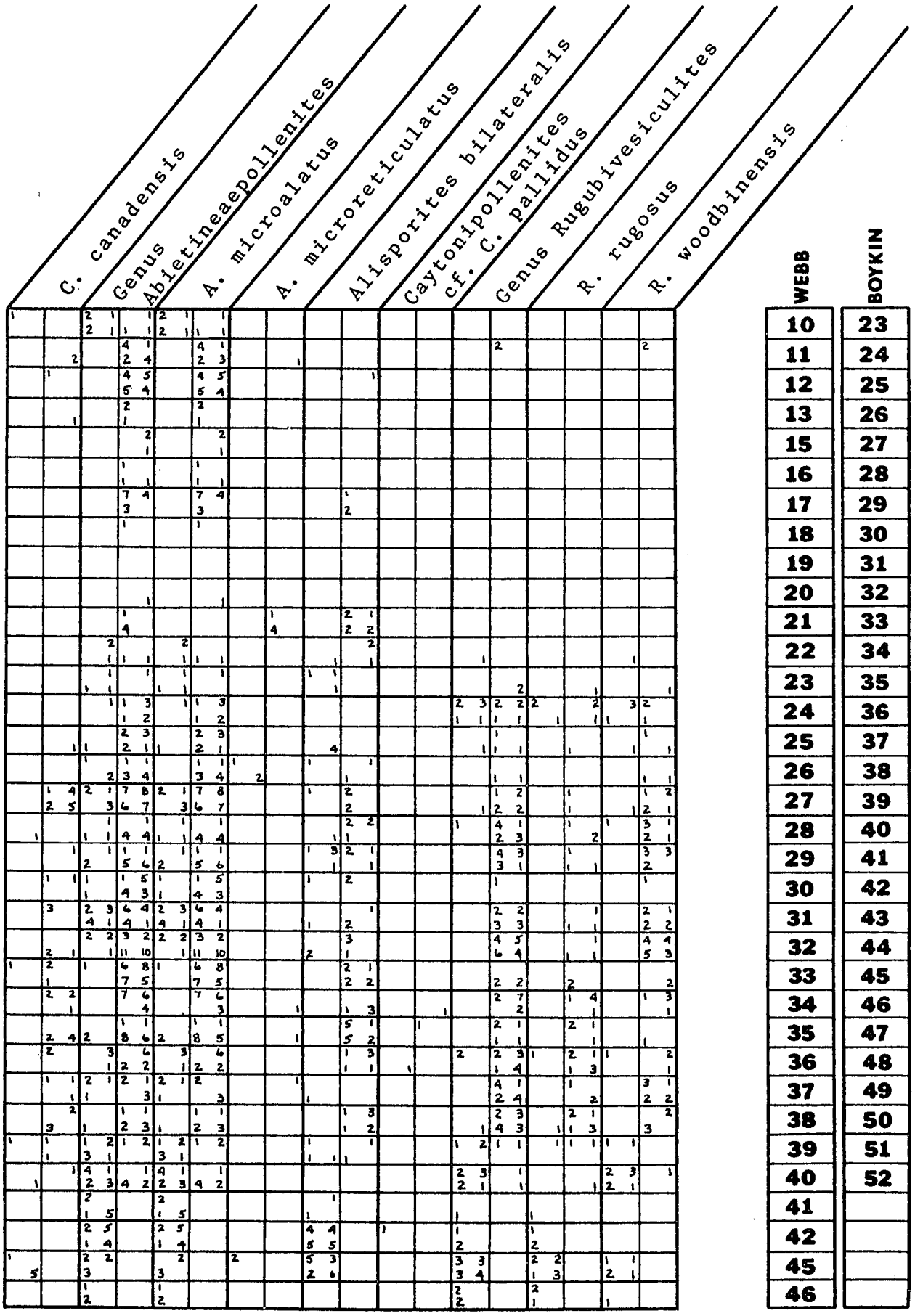
C. canadensis
Genus Abietineaepollenites
A. microalatus
A. microreticulatus
Alisporites bilateralis
Caytonipollenites cf. C. pallidus
Genus Rugubivesiculites
R. rugosus
R. woodbinensis
WEBB
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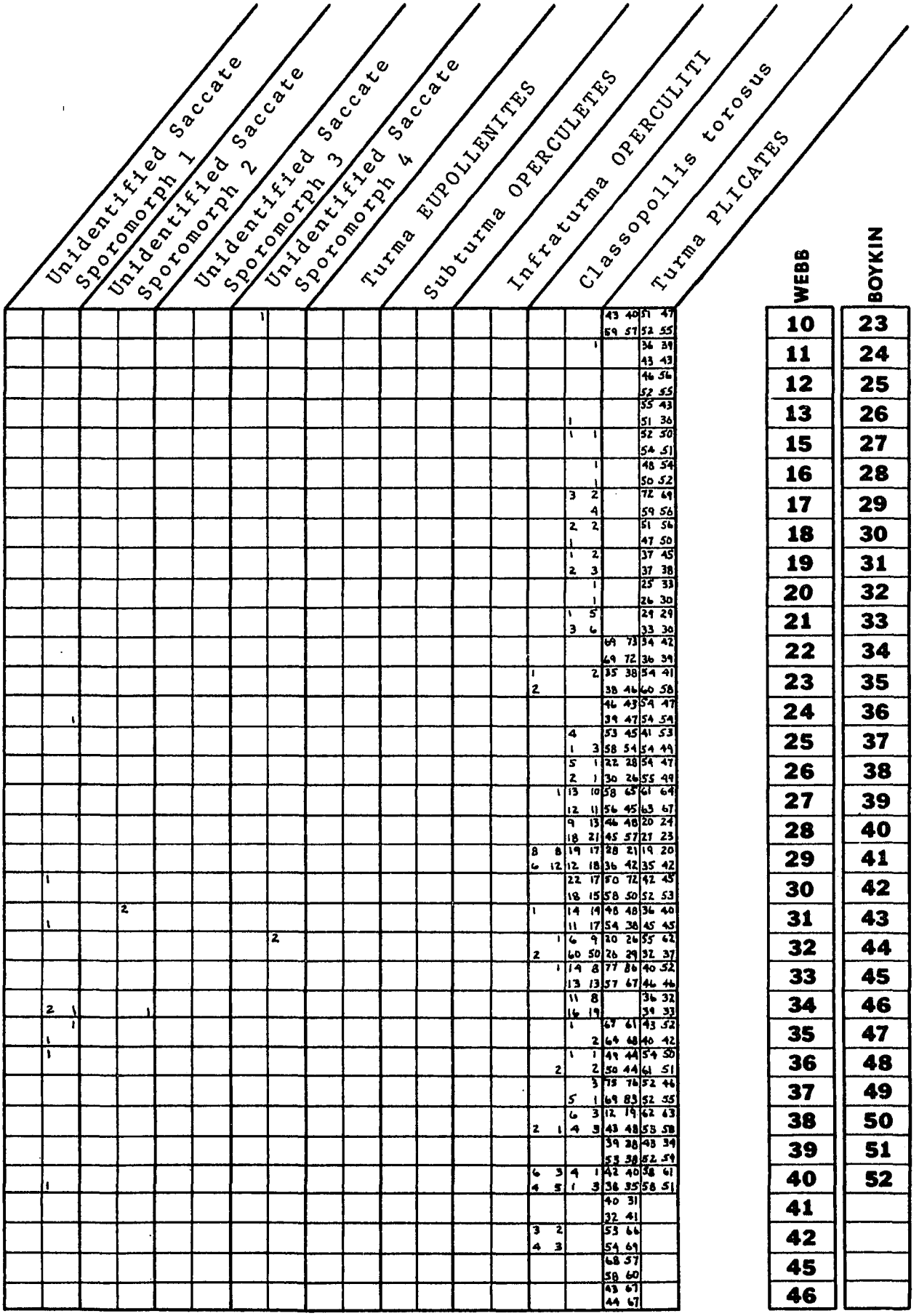
Unidentified Saccate Sporomorph 1
Unidentified Saccate Sporomorph 2
Unidentified Saccate Sporomorph 3
Unidentified Saccate Sporomorph 4
Turma EUPOLLENITES
Subturma OPERCULETES
Infraturma OPERCULITI
Classopollis torosus
Turma PLICATES
WEBB
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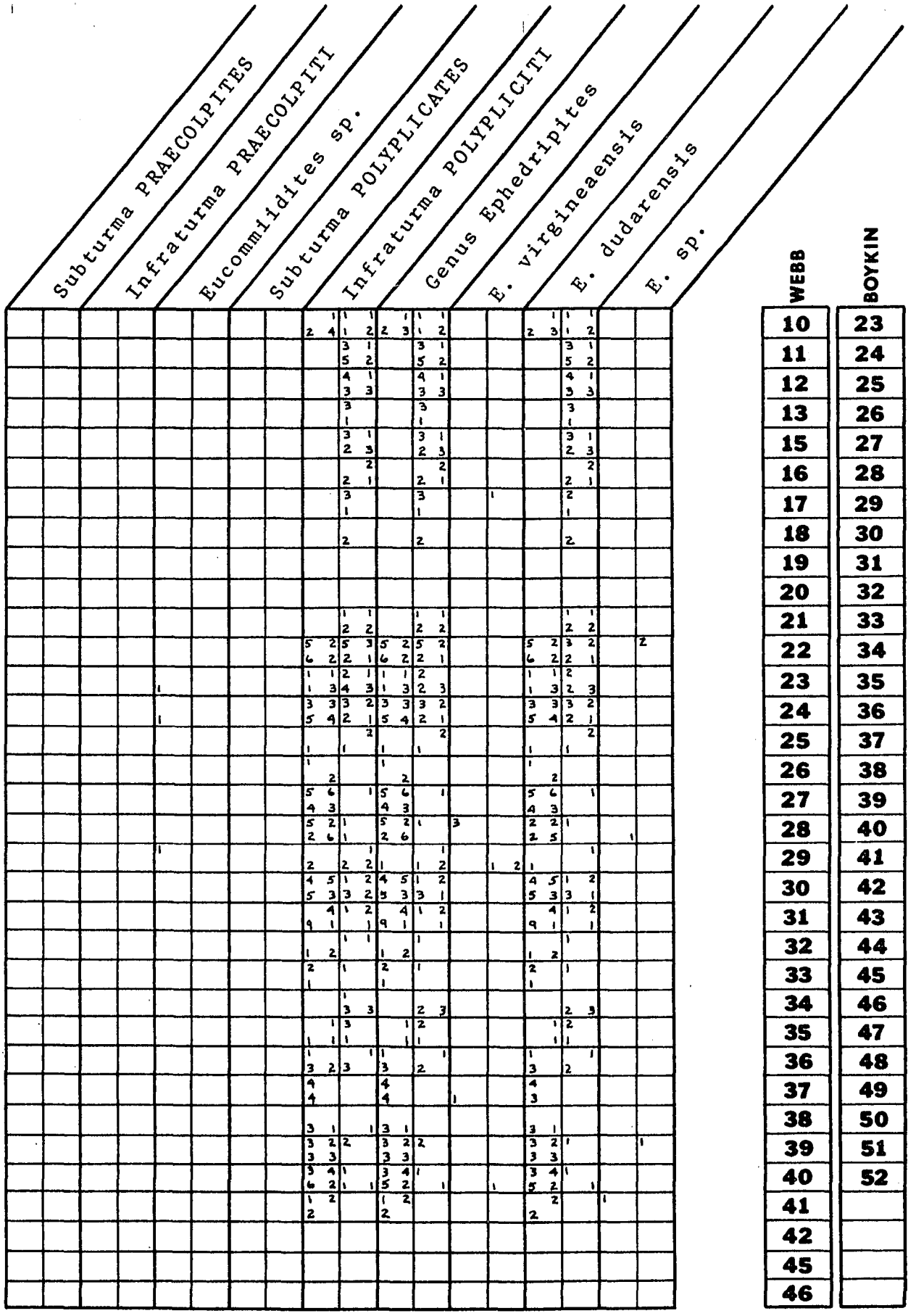
Subturma PRAECOLPITES
Infraturma PRAECOLPITI
Eucommilidites sp.
Subturma POLYPLICATES
Infraturma POLYPLICITI
Genus Ephedripites
E. virgineaensis
E. dudarensis
E. sp.
WEBB
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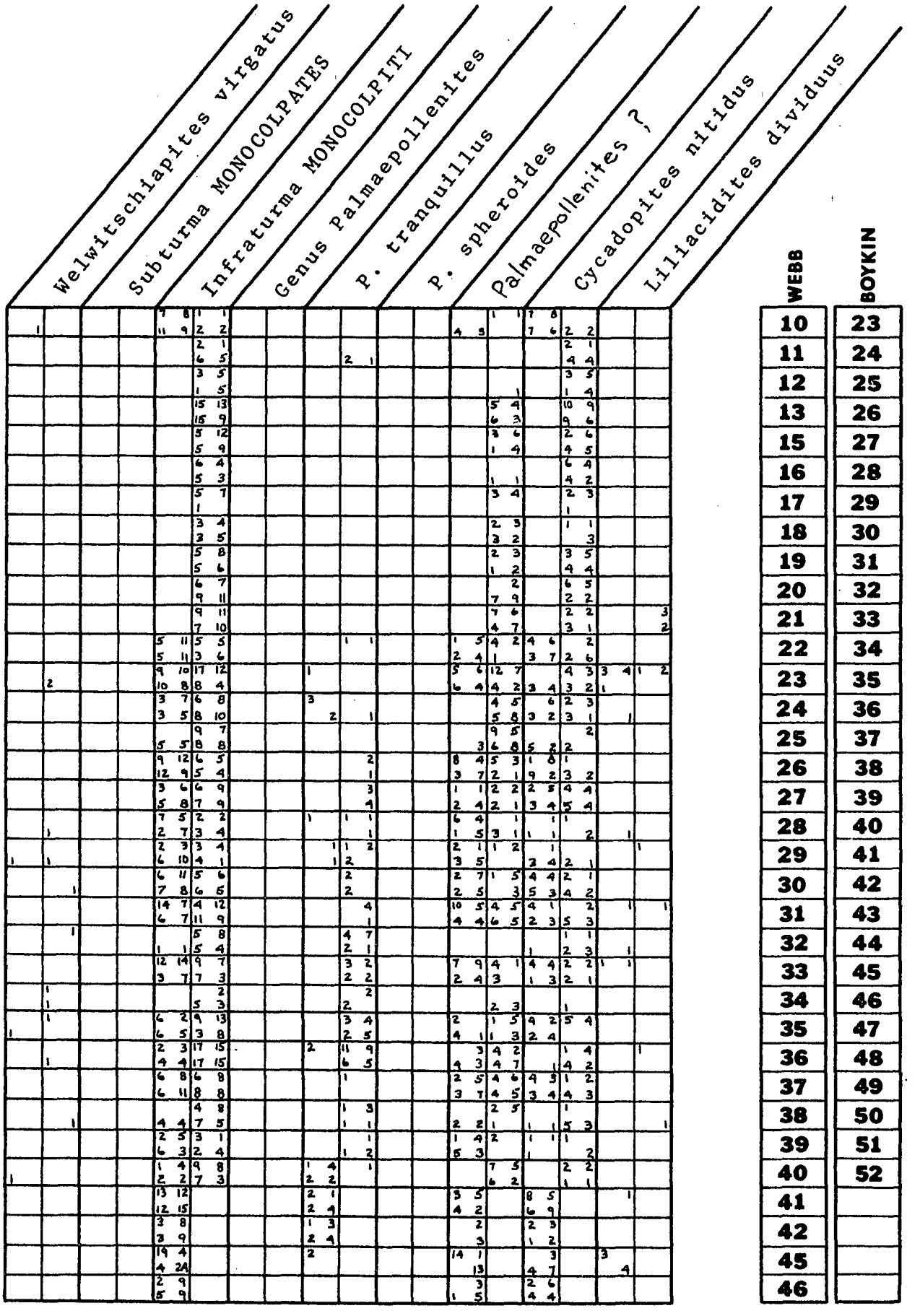
Welwitschiapites virgatus
Subturma MONOCOLPATES
Infraturma MONOCOLPITI
Genus Palmaepollenites
P. tranquillus
P. spheroides
Palmaepollenites ?
Cycadopites nitidus
Liliacidites dividuus
WEBB
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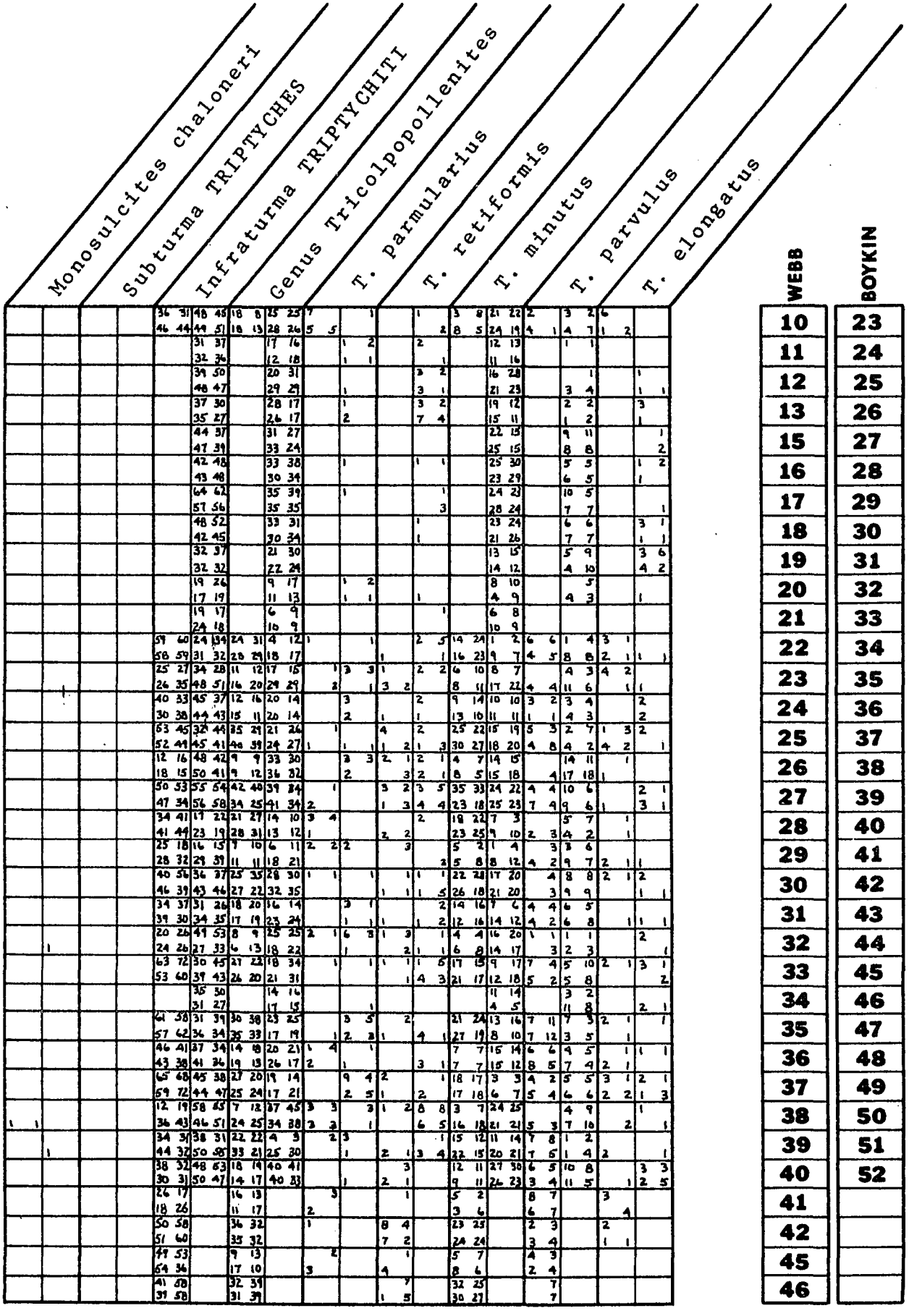
Monosulcites chaloneri
Subturma TRIPTYCHES
Infraturma TRIPTYCHITI
Genus Tricolpopollenites
T. parmularius
T. retiformis
T. minutus
T. parvulus
T. elongatus
WEBB
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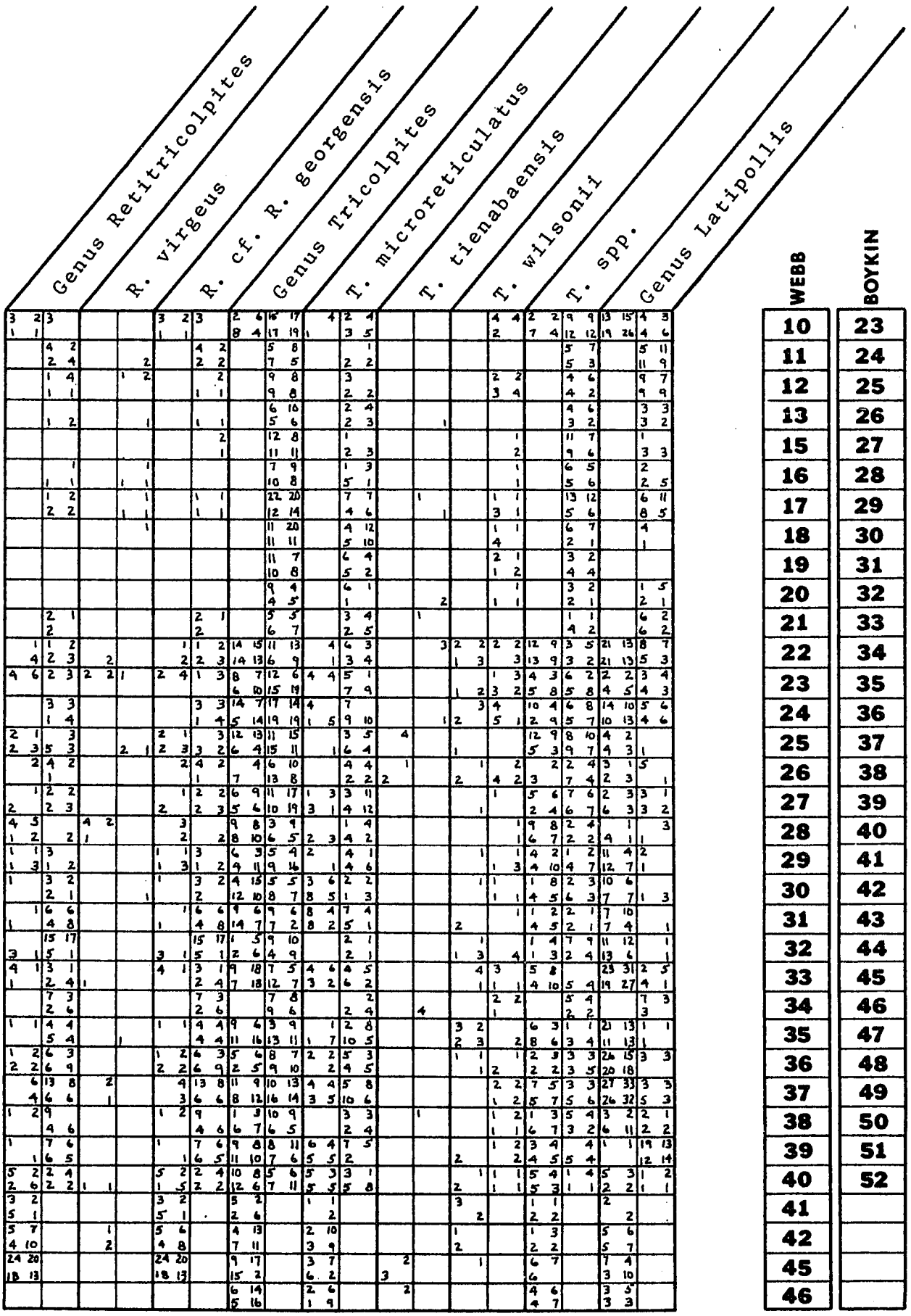
Genus Retitricolpites
R. virgeus
R. cf. R. georgensis
Genus Tricolpites
T. microreticulatus
T. tienabaensis
T. wilsonii
T. spp.
Genus Latipollis
WEBB
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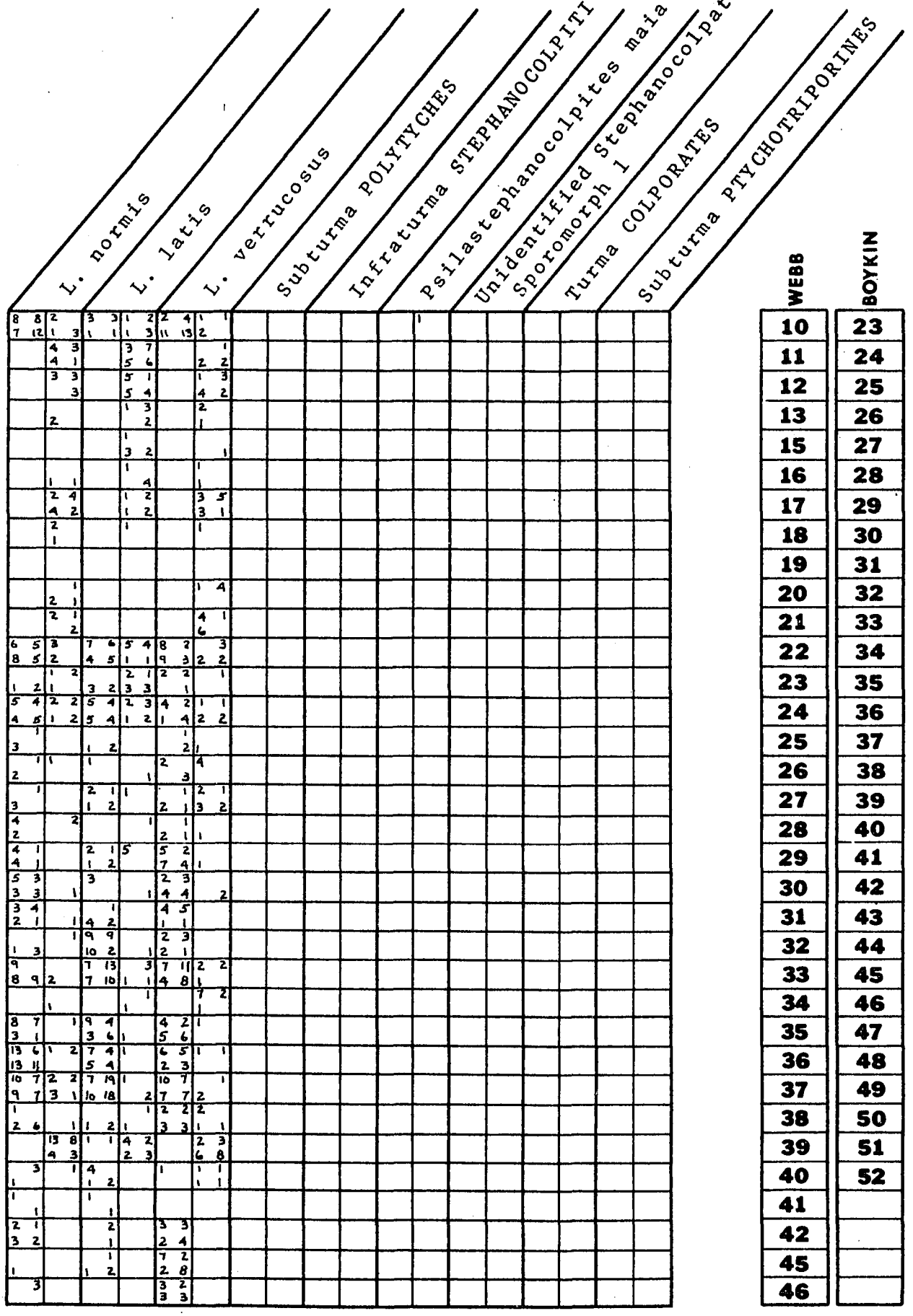

WEBB	BOYKIN
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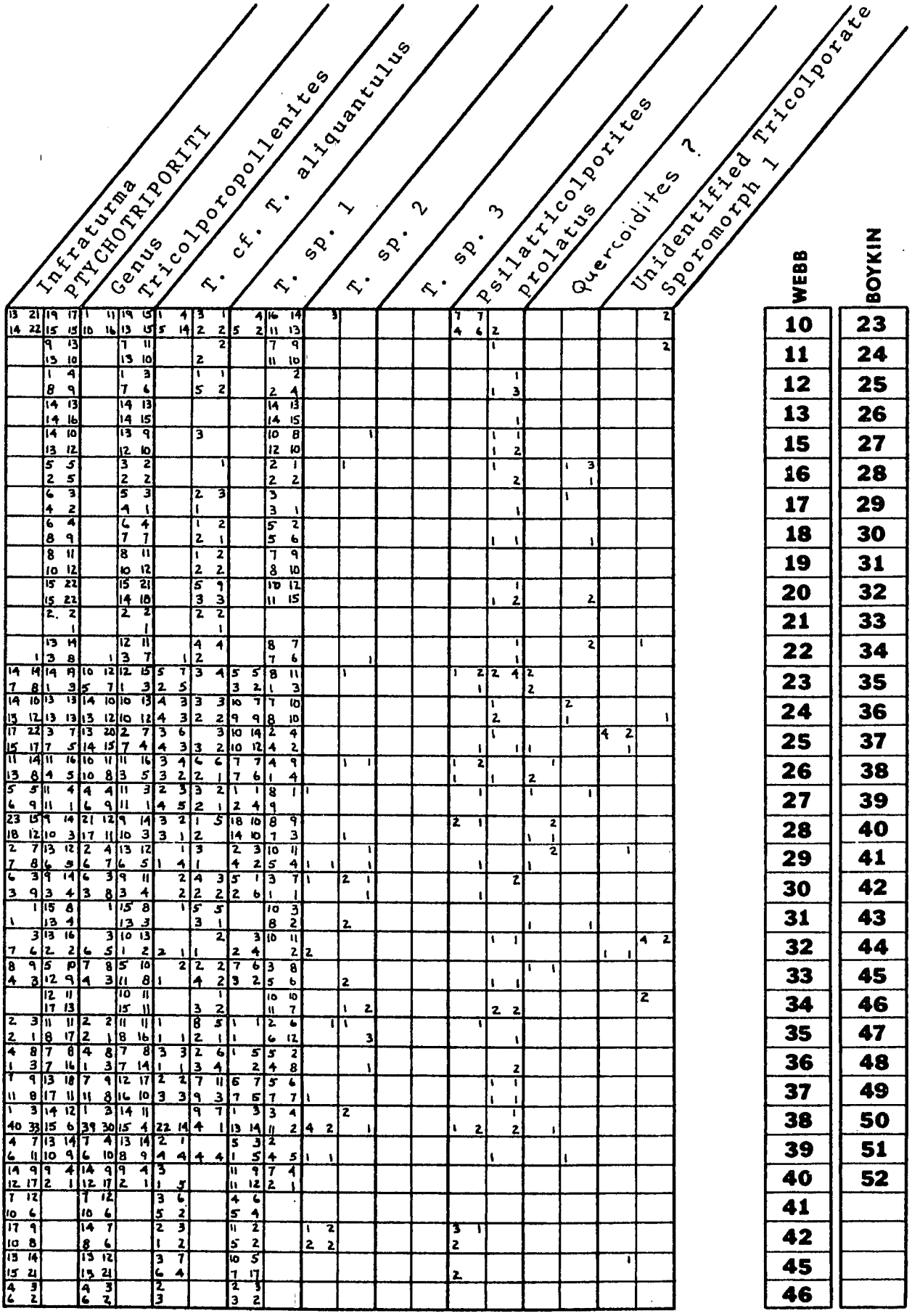
Infraturma PTYCHOTRIPORITI
Genus Tricolporopollenites
T. cf. T. aliquantulus
T. sp. 1
T. sp. 2
T. sp. 3
Psilatricolporites prolatus
Quercoidites ?
Unidentified Tricolporate Sporomorph 1
WEBB
BOYKIN
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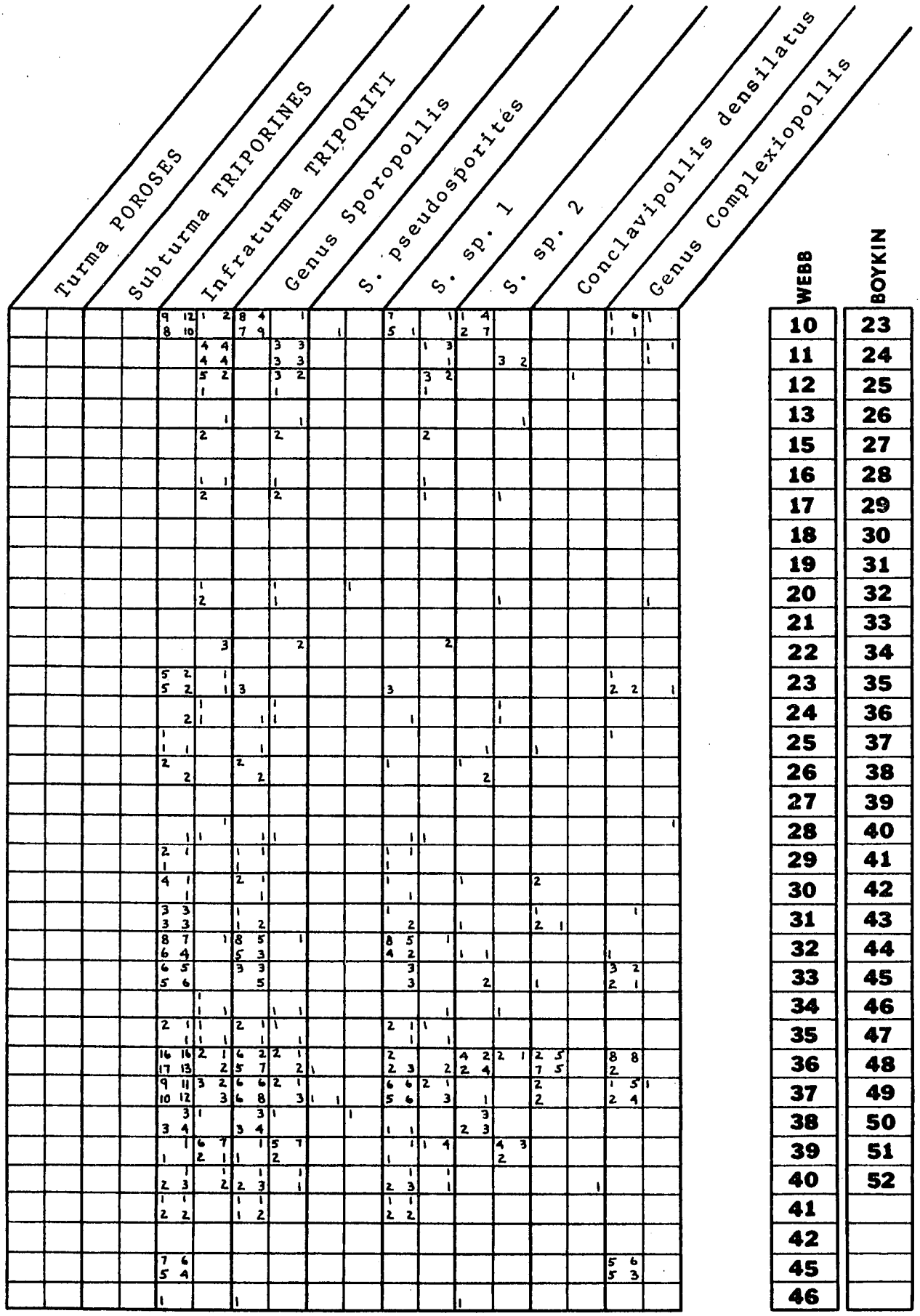
Turma POROSES
Subturma TRIPORINES
Infraturma TRIPORITI
Genus Sporopollis
S. pseudosporites
S. sp. 1
S. sp. 2
Conclavipollis densilatus
Genus Complexiopollis
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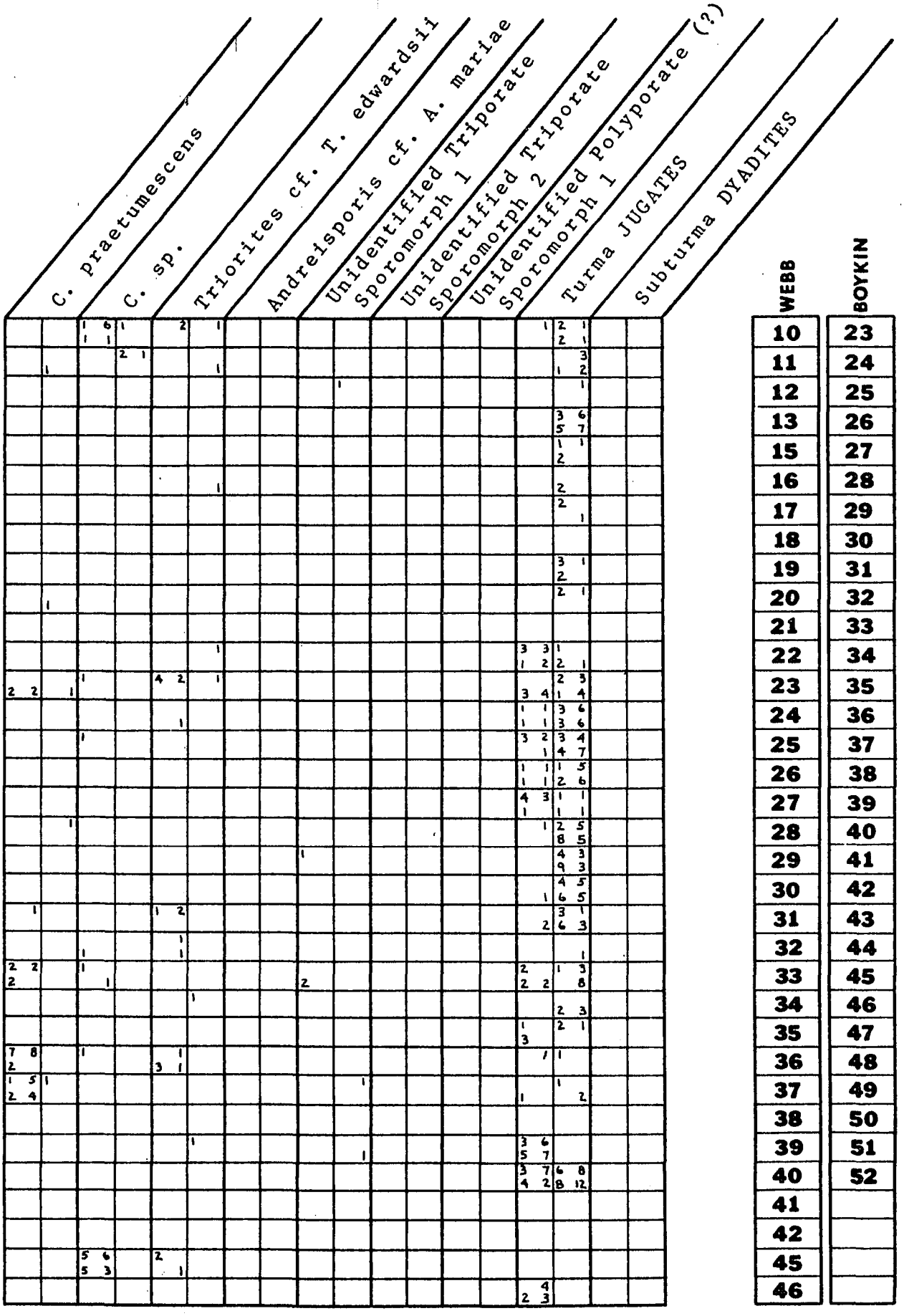
C. praetumescens
C. sp.
Triorites cf. T. edwardsii
Andreisporis cf. A. mariae
Unidentified Triporate Sporomorph 1
Unidentified Triporate Sporomorph 2
Unidentified Polyporate (?) Sporomorph 1
Turma JUGATES
Subturma DYADITES
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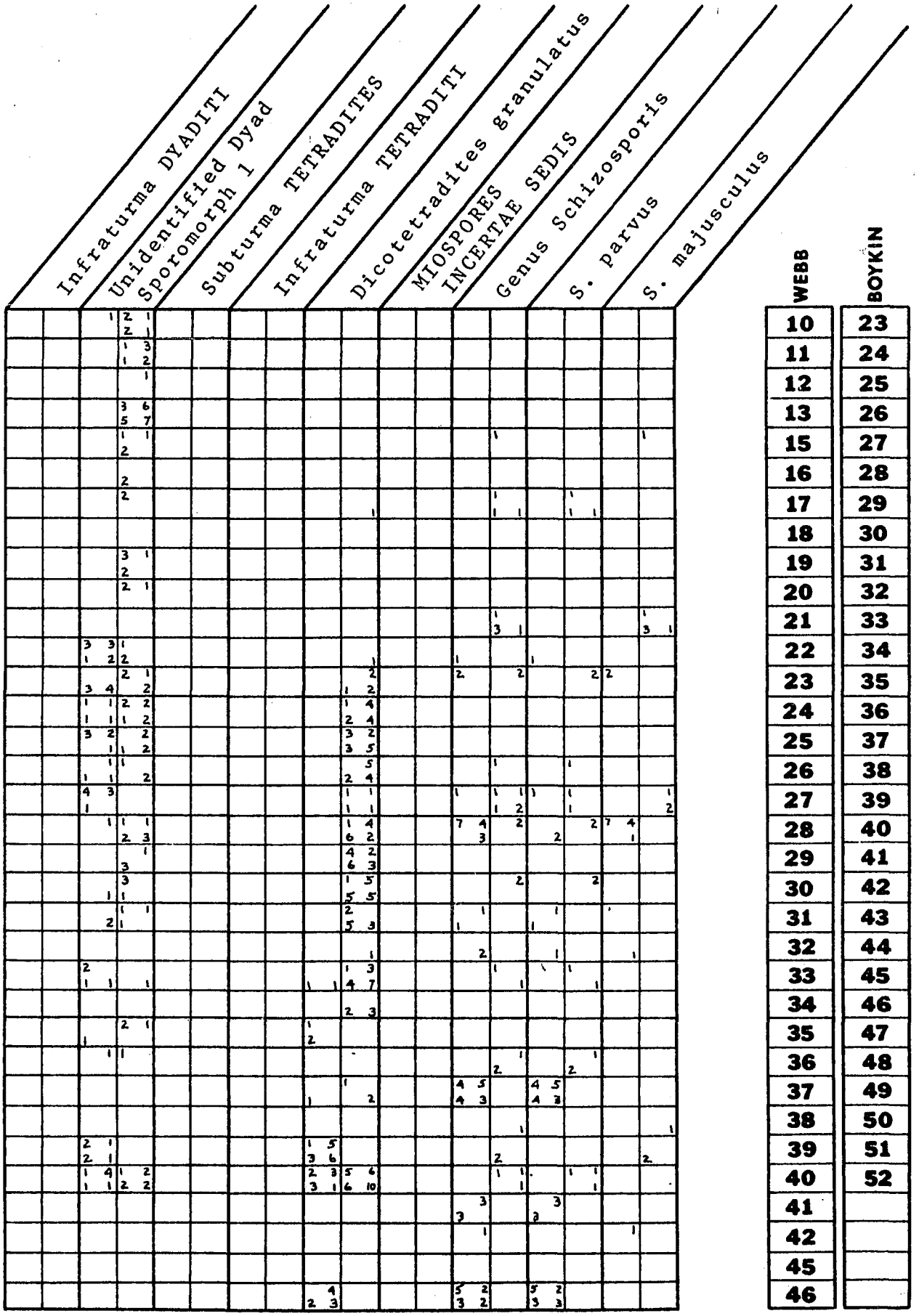
Infraturma DYADITI
Unidentified Dyad Sporomorph 1
Subturma TETRADITES
Infraturma TETRADITI
Dicotetradites granulatus
MIOSPORES INCERTAE SEDIS
Genus Schizosporis
S. parvus
S. majusculus
WEBB
BOYKIN
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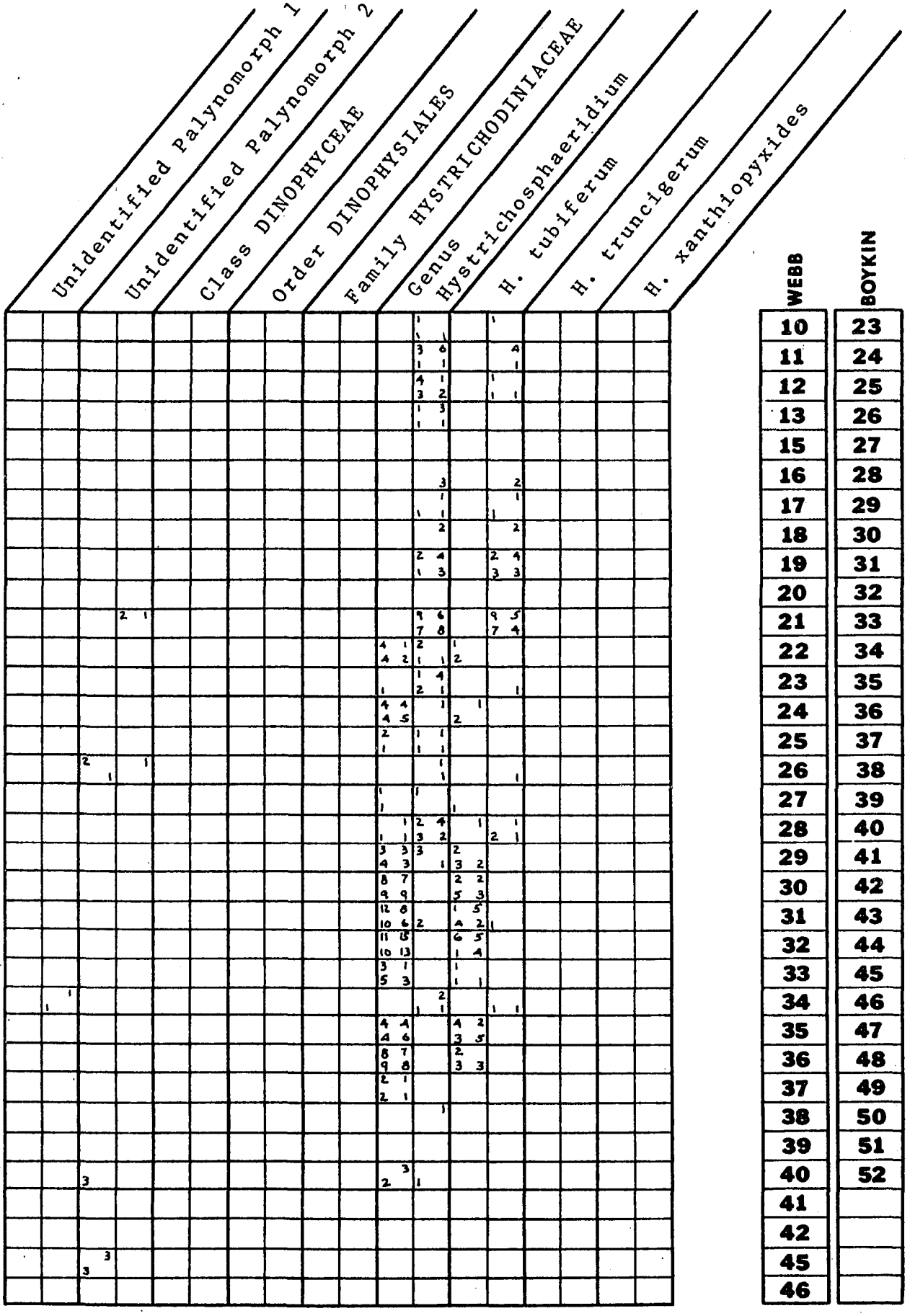
Unidentified Palynomorph 1
Unidentified Palynomorph 2
Class DINOPHYCEAE
Order DINOPHYSIALES
Family HYSTRICHODINIACEAE
Genus Hystrichosphaeridium
H. tubiferum
H. truncigerum
H. xanthiopyxides
WEBB
BOYKIN
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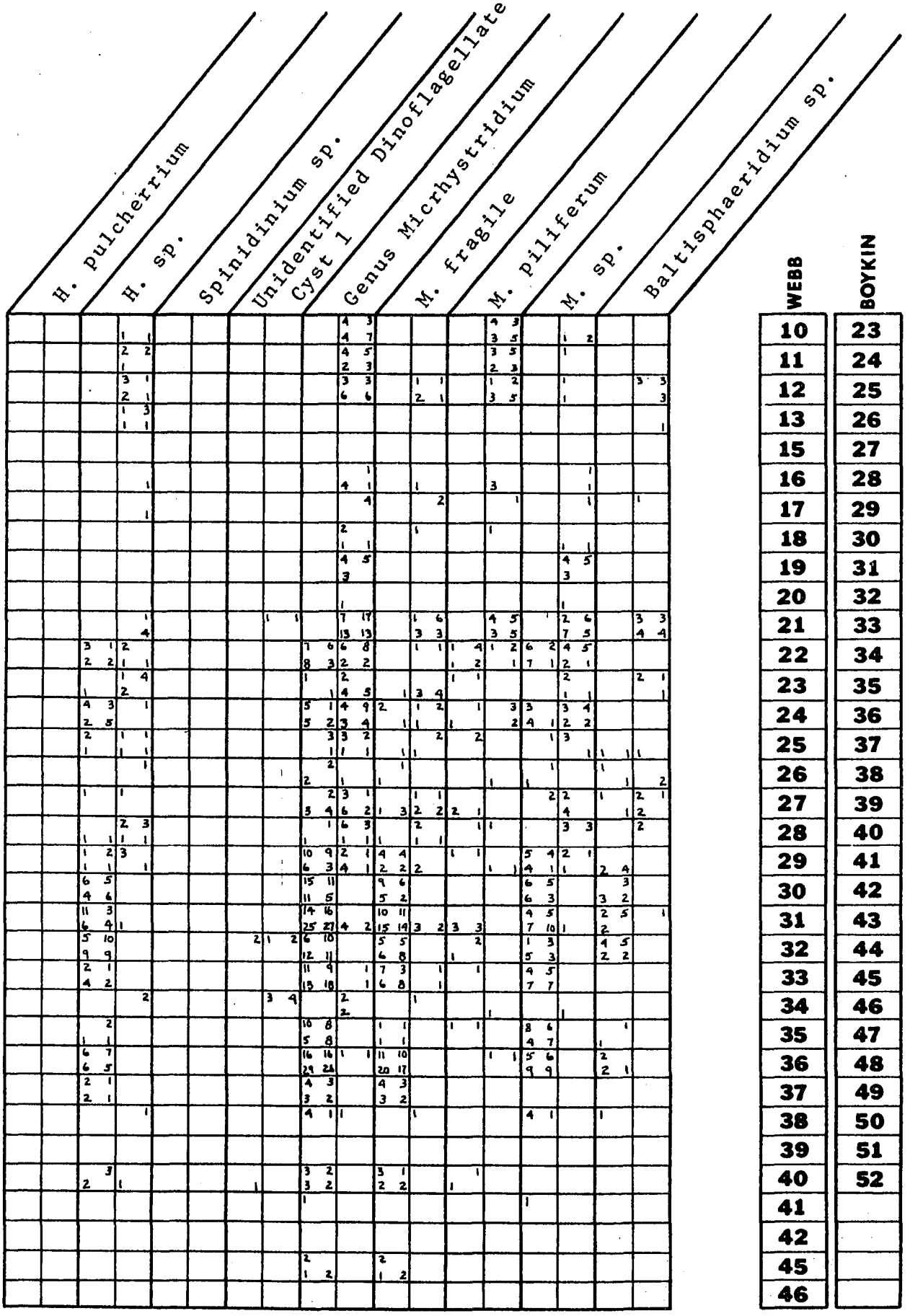
H. pulcherrium
H. sp.
Spinidinium sp.
Unidentified Dinoflagellate Cyst 1
Genus Micrhystridium
M. fragile
M. piliferum
M. sp.
Baltisphaeridium sp.
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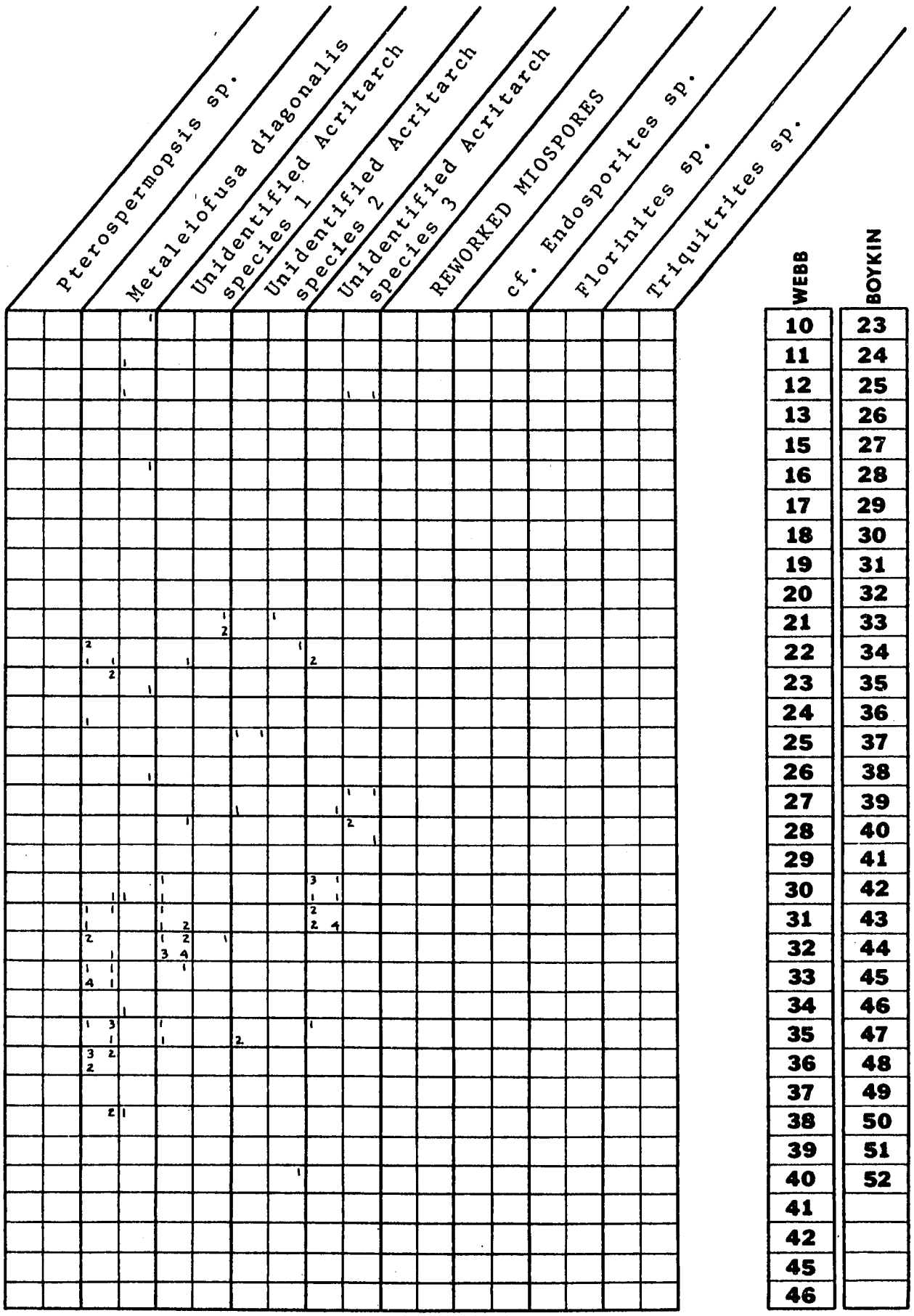
Pterospermopsis sp.
Metaleiofusa diagonalis
Unidentified Acritarch species 1
Unidentified Acritarch species 2
Unidentified Acritarch species 3
REWORKED MIOSPORES
cf. Endosporites sp.
Florinites sp.
Triquitrites sp.
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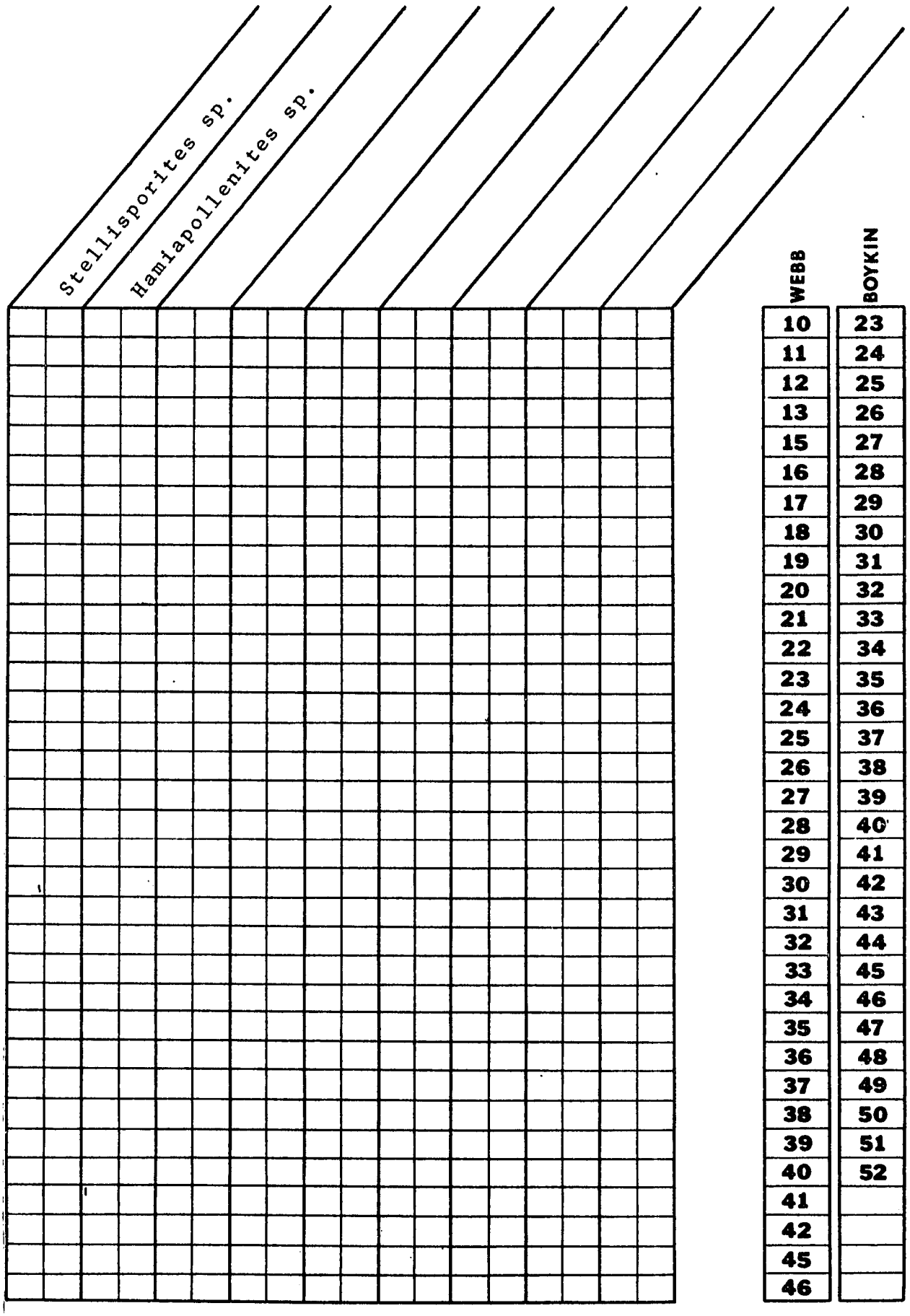
Stellisporites sp.
Hamiapollenites sp.
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APPENDIX C

NESTED ANALYSES OF VARIANCE

The frequency of occurrence of each taxon whose vertical range encompassed five or more samples in at least one of the two cores examined was analyzed according to a nested analysis of variance in a completely randomized design. The linear additive model used to explain the performance of an individual observations is:

$$Y_{ijkl} = \mu + C_i + L_{ij} + S_{ijk} + \varepsilon_{ijkl}$$

where,

Y_{ijkl} = the frequency of occurrence of a given taxon from the lth slide made from the kth sample of the jth lithologic unit taken from the ith core,

μ = the overall mean,

C_i = the effect of the ith core as a deviation from the overall mean (i = 1, 2), NID (0, σ_c^2),

L_{ij} = the effect of the jth lithologic unit from the ith core as a deviation from the mean of all lithologic units from the ith core (j = 1, 2, ..., n, where n is the number of lithologic units sampled between the first appearance and last occurrence of the taxon in the ith core), NID (0, σ_1^2),

S_{ijk} = the effect of the kth sample of the jth lithologic unit from the ith core as a deviation from the mean of all samples taken from the jth lithologic unit in the ith core (k = 1, 2), NID (0, σ^2_s),

ε_{ijkl} = the effect of the lth slide made from the kth sample of the jth lithologic unit in the ith core as a deviation from the mean of all slides made from the kth sample of the jth lithologic unit in the ith core (l = 1, 2), NID (0, σ^2_e).

The analysis for each taxon includes the degrees of freedom, mean square, and variance component associated with each source of variation. The calculations involved in obtaining the appropriate degrees of freedom and mean square can be found in Sokal and Rohlf (1969, pp. 256-265).

Variance components were obtained by equating a given mean square with its expectation, and solving for that variance component. The expectations of the mean squares for the sources of variation included in the nested analyses of variance are:

Cores	$\sigma^2_e + 2\sigma^2_s + 4\sigma^2_1 + k\sigma^2_c$
Lithologic units/Cores	$\sigma^2_e + 2\sigma^2_s + 4\sigma^2_1$
Samples/Lithologic units/Cores	$\sigma^2_e + 2\sigma^2_s$
Slides/Samples/Lithologic units/ Cores	σ^2_e

The coefficient for each variance component represents the number of slides used to obtain means at each level in the hierarchy. A constant number of slides was examined for each sample (two), and a constant number of samples were taken from each lithologic unit (two), resulting in four slides to estimate the mean frequency of occurrence of a taxon in every lithologic unit. Inasmuch as the number of lithologic units varied from core to core, the number of slides per core is represented by a coefficient which is weighted according to the disproportionality in the number of slides examined per core. This coefficient is obtained from the formula:

$$k = n... - \frac{\sum_i n_{i..}^2}{n...}$$

where,

$n...$ = the total number of slides examined in a given analysis,

$n_{i..}$ = the number of slides examined from the ith core.

Estimates of variance components which are negative retained their negative values when used to solve for estimates of other variance components, but are presented as 0.0000 in this Appendix, as a negative value is assumed to estimate a zero variance component.

Significance at the .05 level of probability is indicated by (*), and significance at the .01 level of probability by (**).

Anteturma SPORITES H. Potonié 1893

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	9402.5820**	67.2415
Lithologic units/ Cores	62	829.2917**	202.0309
Samples/Lithologic units/Cores	64	21.1679	0.1719
Slides/Samples/ Lithologic units/ Cores	128	20.8242	20.8242

Turma CHARAGMES Hart (in manuscript)

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	8446.0352**	64.0779
Lithologic units/ Cores	62	276.0908**	64.9124
Samples/Lithologic units/Cores	64	16.4414	0.5547
Slides/Samples/ Lithologic units/ Cores	128	15.3320	15.3320

Subturma TRILETES (Reinch 1881)

R. Potonié and Kremp 1954

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	7902.5781**	60.1356
Lithologic units/ Cores	62	235.2799**	54.9420
Samples/Lithologic units/Cores	64	15.5117	0.9922
Slides/Samples/ Lithologic units/ Cores	128	13.5273	13.5273

Infraturma Laevigati (Bennie and Kidston 1886)

R. Potonié 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	3198.5676**	24.5185
Lithologic units/ Cores	62	72.4623**	15.8285
Samples/Lithologic units/Cores	64	9.1484	0.1406
Slides/Samples/ Lithologic units/ Cores	128	8.8672	8.8672

Calamospora mesozoica Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	235		
Cores	1	0.1067	0.0000
Lithologic units/ Cores	57	3.9147**	0.6164
Samples/Lithologic units/Cores	59	1.4492**	0.3644
Slides/Samples/ Lithologic units/ Cores	118	0.7203	0.7203

Triplanosporites sinuosus Pflug 1952

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	207		
Cores	1	1.7804	0.0054
Lithologic units/ Cores	50	1.2292**	0.2556
Samples/Lithologic units/Cores	52	0.2067	0.0000
Slides/Samples/ Lithologic units/ Cores	104	0.3510	0.3510

Genus Cyathidites Couper 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	1985.9221**	15.2383
Lithologic units/ Cores	62	43.0393**	9.2090
Samples/Lithologic units/Cores	64	6.2031	0.5234
Slides/Samples/ Lithologic units/ Cores	128	5.1563	5.1563

Cyathidites australis Couper 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	27.3421**	0.1448
Lithologic units/ Cores	62	8.8775**	1.9459
Samples/Lithologic units/Cores	64	1.0937	0.0000
Slides/Samples/ Lithologic units/ Cores	128	1.4062	1.4062

Cyathidites minor Couper 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	1547.2195**	11.9288
Lithologic units/ Cores	62	26.2946**	5.4799
Samples/Lithologic units/Cores	64	4.3750	0.6680
Slides/Samples/ lithologic units/ Cores	128	3.0391	3.0391

Divisporites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	215		
Cores	1	0.0868	0.0004
Lithologic units/ Cores	52	0.0471	0.0000
Samples/Lithologic units/Cores	54	0.0556	0.0093
Slides/Samples/ Lithologic units/ Cores	108	0.0370	0.0370

Genus Undulatisporites Pflug in Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	175		
Cores	1	0.0000	0.0000
Lithologic units/ Cores	42	0.0729	0.0083
Samples/Lithologic units/Cores	44	0.0398	0.0000
Slides/Samples/ Lithologic units/ Cores	88	0.0625	0.0625

Undulatisporites undulapolus Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	55		
Cores	1	0.1113	0.0016
Lithologic units/ Cores	12	0.0994	0.0114
Samples/Lithologic units/Cores	14	0.0536	0.0000
Slides/Samples/ lithologic units/ Cores	28	0.0893	0.0893

Undulatisporites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	111		
Cores	1	0.0067	0.0000
Lithologic units/ Cores	26	0.0451	0.0000
Samples/Lithologic units/Cores	28	0.0536	0.0000
Slides/Samples/ Lithologic units/ Cores	56	0.0536	0.0536

Stereisporites antiquasporites (Wilson and Webster 1946) Dettmann 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	115		
Cores	1	0.1734	0.0007
Lithologic units/ Cores	27	0.1347	0.0000
Samples/Lithologic units/Cores	29	0.0862	0.0000
Slides/Samples/ Lithologic units/ Cores	58	0.1379	0.1379

Leiotriletes paramaximus Krutzsch 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	175		
Cores	1	0.0473	0.0000
Lithologic units/ Cores	42	0.3012	0.0540
Samples/Lithologic units/Cores	44	0.0852	0.0000
Slides/Samples/ Lithologic units/ Cores	88	0.0966	0.0966

Genus Deltoidospora Miner 1935 emend. R. Potonie 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	63.6598**	0.4858
Lithologic units/ Cores	60	3.6762	0.6136
Samples/Lithologic units/Cores	62	1.2218	0.0000
Slides/Samples/ Lithologic units/ Cores	124	1.4315	1.4315

Deltoidospora hallii Miner 1935

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	5.8244	0.4425
Lithologic units/ Cores	60	3.6021**	0.5779
Samples/Lithologic units/Cores	62	1.2903	0.0000
Slides/Samples/ Lithologic units/ Cores	124	1.4032	1.4032

Deltoidospora juncta (Kara-Murza 1961) Singh 1964

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	83		
Cores	1	0.1167	0.0046
Lithologic units/ Cores	19	0.0816	0.0000
Samples/Lithologic units/Cores	21	0.;071	0.0238
Slides/Samples/ Lithologic units/ Cores	42	0.0595	0.0595

Genus Todisporites Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	227		
Cores	1	1.8757	0.0047
Lithologic units/ Cores	55	1.3488	0.0094
Samples/Lithologic units/Cores	57	1.3114**	0.5307
Slides/Samples/ Lithologic units/ Cores	114	0.2500	0.2500

Todisporites minor Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	227		
Cores	1	2.7759*	0.0200
Lithologic units/ Cores	55	0.5540	0.0464
Samples/Lithologic units/Cores	57	0.3684**	0.0965
Slides/Samples/ Lithologic units/ Cores	114	0.1754	0.1754

Todisporites scabratus Groot and Groot 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	115		
Cores	1	0.3137	0.0000
Lithologic units/ Cores	27	1.8773	0.0016
Samples/Lithologic units/Cores	29	1.8707**	0.8448
Slides/Samples/ Lithologic units/ Cores	58	0.1810	0.1810

Dictyophyllidites cf. *D. harrisii* Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	79		
Cores	1	0.1684	0.0139
Lithologic units/ Cores	18	0.0629	0.0000
Samples/Lithologic units/Cores	20	0.0750	0.0000
Slides/Samples/ Lithologic units/ Cores	40	0.0750	0.0750

Plicifera delicata (Bolkhovitina 1953) Bolkhovitina 1967

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	83		
Cores	1	1.2595	0.0326
Lithologic units/ Cores	19	0.2658	0.0000
Samples/Lithologic units/Cores	21	0.3690**	0.1190
Slides/Samples/ Lithologic units/ Cores	42	0.1310	0.1310

Unidentified Laevigate Sporomorph 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	235		
Cores	1	0.2015	0.0000
Lithologic units/ Cores	57	0.3221**	0.0381
Samples/Lithologic units/Cores	59	0.1695	0.0212
Slides/Samples Lithologic units/ Cores	118	0.1271	0.1271

Infraturma APICULATI (Bennie and Kidston 1886)

R. Potonié 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	75.2924	0.4082
Lithologic units/ Cores	62	23.2503**	5.5245
Samples/Lithologic units/Cores	64	1.1523	0.0000
Slides/Samples/ Lithologic units/ Cores	128	1.6289	1.6289

Trilites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	89.8603**	0.6399
Lithologic units/ Cores	62	8.2621**	1.8448
Samples/Lithologic units/Cores	64	0.8828	0.0000
Slides/Samples/ Lithologic units/ Cores	128	0.9844	0.9844

Genus Acanthotriletes Naumova 1937 ex R. Potonie and Kremp 1954

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	243		
Cores	1	0.5196	0.0000
Lithologic units/ Cores	59	8.4344**	1.9682
Samples/Lithologic units/Cores	61	0.5615	0.0820
Slides/Samples/ Lithologic units/ Cores	122	0.3975	0.3975

Acanthotriletes levidensis Balme 1957

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	103		
Cores	1	0.1119	0.0020
Lithologic units/ Cores	24	0.0582	0.0000
Samples/Lithologic units/Cores	26	0.0673	0.0000
Slides/Samples/ Lithologic units/ Cores	52	0.0673	0.0673

Acanthotriletes varispinosus Pocock 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	99		
Cores	1	0.7656	0.0084
Lithologic units/ Cores	23	0.3798	0.0600
Samples/Lithologic units/Cores	25	0.1400	0.0000
Slides/Samples/ Lithologic units/ Cores	50	0.1800	0.1800

Acanthotriletes sp. 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	47		
Cores	1	1.7045**	0.2182
Lithologic units/ Cores	10	0.1045	0.0000
Samples/Lithologic units/Cores	12	0.1250	0.0000
Slides/Samples/ Lithologic units/ Cores	24	0.2083	0.2803

Acanthotriletes sp. 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	135		
Cores	1	1.7210	0.0000
Lithologic units/ Cores	32	12.7543**	2.9772
Samples/Lithologic units/Cores	34	0.8456**	0.2426
Slides/Samples/ Lithologic units/ Cores	68	0.3603	0.3603

Unidentified Apiculate Spormorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	131		
Lithologic units	32	0.0852	0.0137
Samples/Lithologic units	33	0.0303	0.0000
Slides/Samples/ Lithologic units/ Cores	66	0.0606	0.0606

Unidentified Apiculate Sporomorph 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	223		
Cores	1	0.0179	0.0000
Lithologic units/ Cores	54	0.6951**	0.1247
Samples/Lithologic units/Cores	56	0.1964**	0.0491
Slides/Samples/ Lithologic units/ Cores	112	0.0982	0.0982

Infraturma Muronati R. Potonie and Kremp 1954

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	559.9587**	4.0589
Lithologic units/ Cores	62	42.4520**	9.2829
Samples/Lithologic units/Cores	64	5.3203	0.6055
Slides/Samples/ Lithologic units/ Cores	128	4.1094	4.1094

Genus Cicatricosisporites R. Potonie and Gelletich 1933

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	399.3755**	2.9593
Lithologic units/ Cores	62	22.0703**	4.4512
Samples/Lithologic units/Cores	64	4.2656	0.4180
Slides/Samples/ Lithologic units/ Cores	128	3.4297	3.4297

Cicatricosisporites dorogensis R. Potonié and Gelletich 1933

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	72.3156**	0.5328
Lithologic units/ Cores	60	6.8670**	1.2087
Samples/Lithologic units/Cores	62	2.0323*	0.3831
Slides/Samples/ Lithologic units/ Cores	124	1.2661	1.2661

Cicatricosisporites australiensis (Cookson 1953) R. Potonié 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	147		
Cores	1	0.7926*	0.0715
Lithologic units/ Cores	35	0.1858	0.004?
Samples/Lithologic units/Cores	37	0.1689	0.0000
Slides/Samples/ Lithologic units/ Cores	74	0.1824	0.1824

Cicatricosisporites carlylensis Pocock 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	199		
Cores	1	0.1637	0.0000
Lithologic units/ Cores	48	0.9657**	0.1514
Samples/Lithologic units/Cores	50	0.3600	0.0000
Slides/Samples/ Lithologic units/ Cores	100	0.3900	0.3900

Cicatricosisporites venustus Deák 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	93.9129**	0.7107
Lithologic units/ Cores	62	3.2988**	0.4185
Samples/Lithologic units/Cores	64	1.6250	0.0000
Slides/Samples/ Lithologic units/ Cores	128	1.8672	1.8672

Cicatricosisporites lucifer Hughes and Moody-Stuart 1967

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	167		
Cores	1	1.2735	0.0092
Lithologic units/ Cores	40	0.6158	0.0617
Samples/Lithologic units/Cores	42	0.3690	0.0000
Slides/Samples/ Lithologic units/ Cores	84	0.4762	0.4762

Cicatricosisporites coconinoensis Agasie 1969

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	239		
Cores	1	0.3719	0.0003
Lithologic units/ Cores	58	0.3416**	0.0521
Samples/Lithologic units/Cores	60	0.1333	0.0000
Slides/Samples/ Lithologic units/ Cores	120	0.1417	0.1417

Lygodioisporites cf. *L. perverrucatus* Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	71		
Lithologic units	17	0.1340	0.0000
Samples/Lithologic units	18	0.1389	0.0000
Slides/Samples/ Lithologic units	36	0.1389	0.1389

Chomotriletes fragilis Pocock 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	35		
Lithologic units	8	0.7153	0.0000
Samples/Lithologic units	9	0.8333*	0.2778
Slides/Samples/ Lithologic units	18	0.2778	0.2778

Rugulatisporites caperatus van Hoeken-Klinkenberg 1964

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	231		
Cores	1	0.0172	0.0000
Lithologic units/ Cores	56	0.3642	0.0329
Samples/Lithologic units/Cores	58	0.2328	0.0000
Slides/Samples/ Lithologic units/ Cores	116	0.3103	0.3103

Microreticulatisporites pseudofoveolatus Deák 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	131		
Lithologic units	32	0.0644	0.0066
Samples/Lithologic units	33	0.0379	0.0000
Slides/Samples/ Lithologic units	66	0.0530	0.0530

Genus Foveotriletes van der Hammen 1954 ex R. Potonie 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	91		
Cores	1	0.0524	0.0000
Lithologic units/ Cores	21	0.4240	0.0326
Samples/Lithologic units/Cores	23	0.2935	0.0326
Slides/Samples/ Lithologic units/ Cores	46	0.2283	0.2283

Foveotriletes subtriangularis Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	71		
Cores	1	0.8897	0.0662
Lithologic units/ Cores	16	0.3897	0.0106
Samples/Lithologic units/Cores	18	0.3472	0.0694
Slides/Samples/ Lithologic units/ Cores	36	0.2083	0.2083

Klukisporites pseudoreticulatus Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	175		
Cores	1	0.0512	0.0000
Lithologic units/ Cores	42	0.3976*	0.0454
Samples/Lithologic units/Cores	44	0.2159**	0.0795
Slides/Samples/ Lithologic units/ Cores	88	0.0568	0.0568

Genus Retitriletes Pierce 1961

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	191		
Cores	1	0.0292	0.0000
Lithologic units/ Cores	46	0.8576**	0.1779
Samples/Lithologic units/Cores	48	0.1458	0.0104
Slides/Samples/ Lithologic units/ Cores	96	0.1250	0.1250

Retitriletes pluricellulus Pierce 1961

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	45		
Lithologic units	11	0.0603	0.0098
Samples/Lithologic units	12	0.0227	0.0000
Slides/Samples/ Lithologic units	24	0.0435	0.0435

Retitriletes cenomanianus Agasie 1969

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	191		
Cores	1	0.0000	0.0000
Lithologic units/ Cores	46	0.8478**	0.1807
Samples/Lithologic units/Cores	48	0.1250	0.0000
Slides/Samples/ Lithologic units/ Cores	96	0.1250	0.1250

Costatoperforosporites spp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	191		
Cores	1	0.0003	0.0000
Lithologic units/ Cores	46	0.2894	0.0359
Samples/Lithologic units/Cores	48	0.1458	0.0000
Slides/Samples/ Lithologic units/ Cores	96	0.2187	0.2187

Unidentified Muronate Sporomorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	59		
Lithologic units	14	0.0310	0.0000
Samples/Lithologic units	15	0.0333	0.0000
Slides/Samples/ Lithologic units	30	0.0333	0.0333

Unidentified Muronate Sporomorph 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	75		
Lithologic units	18	0.2588*	0.0581
Samples/Lithologic units	19	0.0263	0.0000
Slides/Samples/ Lithologic units	38	0.1579	0.1579

Unidentified Muronate Sporomorph 3

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	123		
Cores	1	0.0375	0.0000
Lithologic units/ Cores	29	0.0994	0.0000
Samples/Lithologic units/Cores	31	0.1452*	0.0322
Slides/Samples/ Lithologic units/ Cores	62	0.0806	0.0806

Unidentified Muronate Sporomorph

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	67		
Cores	1	0.2723	0.0037
Lithologic units/ Cores	15	0.1505*	0.0192
Samples/Lithologic units/Cores	17	0.0735	0.0000
Slides/Samples/ Lithologic units/ Cores	34	0.0735	0.0735

Subturma MONOLETES Ibrahim 1933

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	10.7061	0.0211
Lithologic units/ Cores	61	8.0686**	1.8346
Samples/Lithologic units/Cores	63	0.7302	0.0000
Slides/Samples/ Lithologic units/ Cores	126	1.1905	1.1905

Infraturma LAEVIGATIMONOLETI Dybova and Jackowicz 1957

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	9.7692	0.0136
Lithologic units/ Cores	61	8.0683**	1.8425
Samples/Lithologic units/Cores	63	0.6984	0.0000
Slides/Samples/ Lithologic units/ Cores	126	1.2063	1.2063

Genus Laevigatosporites Ibrahim 1933

Schopf, Wilson and Bentall 1944

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	23.0082**	0.1680
Lithologic units/ Cores	61	1.9706**	0.3518
Samples/Lithologic units/Cores	63	0.5635	0.0000
Slides/Samples/ Lithologic units/ Cores	126	0.7143	0.7143

Laevigatosporites ovatus Wilson and Webster 1946

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	20.9031**	0.1530
Lithologic units/ Cores	61	1.7410**	0.2914
Samples/Lithologic units/Cores	63	0.5754	0.0000
Slides/Samples/ Lithologic units/ Cores	126	0.6865	0.6865

Laevigatosporites albertensis Rouse 1957

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	39		
Cores	1	0.2250	0.0062
Lithologic units/ Cores	8	0.0999	0.0000
Samples/Lithologic units/Cores	10	0.1250	0.0000
Slides/Samples/ Lithologic units/ Cores	20	0.1750	0.1750

Monolites intragranulosus Singh, Srivastava and Roy 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	115		
Cores	1	26.2069	0.3191
Lithologic units/ Cores	27	9.4815**	2.3079
Samples/Lithologic units/Cores	29	0.2500	0.0000
Slides/Samples/ Lithologic units/ Cores	58	0.4914	0.4914

Verrucatosporites pseudoreticulatus Hedlund 1966

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	75		
Cores	1	0.1645	0.0168
Lithologic units/ Cores	17	0.0368	0.0000
Samples/Lithologic units/Cores	19	0.0526	0.0000
Slides/Samples/ Lithologic units/ Cores	38	0.0526	0.0526

Subturma ZONOTRILETES Valts 1955

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	27.6054	0.0000
Lithologic units/ Cores	61	79.9549**	15.3022
Samples/Lithologic units/Cores	63	18.7460**	8.5079
Slides/Samples/ Lithologic units/ Cores	126	1.7302	1.7302

Infraturma ZONATI R. Potonié and Kremp 1954

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	227		
Cores	1	49.2737	0.0000
Lithologic units/ Cores	55	85.3586**	15.9219
Samples/Lithologic units/Cores	57	21.6711**	10.3377
Slides/Samples/ Lithologic units/ Cores	114	0.9956	0.9956

Cirratriradites teter Norris 1967

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	159		
Cores	1	72.2486	0.0000
Lithologic units/ Cores	38	87.5191**	21.4735
Samples/Lithologic units/Cores	40	1.6250	0.1250
Slides/Samples/ Lithologic units/ Cores	80	1.3750	1.3750

Rouseisporites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	71		
Lithologic units	17	0.0261	0.0000
Samples/Lithologic units	18	0.0278	0.0000
Slides/Samples/ Lithologic units	36	0.0278	0.0278

Unidentified Zonate Sporomorph 3

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	131		
Lithologic units	32	0.0513	0.0002
Samples/Lithologic units	33	0.0505**	0.0138
Slides/Samples/ Lithologic units	66	0.0231	0.0231

Infraturma CINGULATI R. Potonie and Kremp 1954

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	171		
Cores	1	0.1000	0.0000
Lithologic units/ Cores	41	0.6604*	0.0706
Samples/Lithologic units/Cores	43	0.3770**	0.1512
Slides/Samples/ Lithologic units/ Cores	86	0.0756	0.0756

Genus Cingulatisporites Thomson in Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	127		
Cores	1	0.0801	0.0014
Lithologic units/ Cores	30	0.0265	0.0000
Samples/Lithologic units/Cores	32	0.0312	0.0000
Slides/Samples/ Lithologic units/ Cores	64	0.0312	0.0312

Cingulatisporites levispeciosus Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	27		
Cores	1	0.0952	0.0042
Lithologic units/ Cores	5	0.0667	0.0000
Samples/Lithologic units/Cores	7	0.1071	0.0000
Slides/Samples/ Lithologic units/ Cores	14	0.1071	0.1071

Unidentified Cingulate Sporomorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	27		
Cores	1	1.0059	0.0531
Lithologic units/ Cores	5	0.6417	0.0711
Samples/Lithologic units/Cores	7	0.3571	0.0714
Slides/Samples/ Lithologic units/ Cores	14	0.2143	0.2143

Unidentified Cingulate Sporomorph 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	59		
Lithologic units	14	0.0309	0.0000
Samples/Lithologic units	15	0.0333	0.0000
Slides/Samples/ Lithologic units	30	0.0333	0.0333

Genus Appendicisporites Weyland and Kreiger 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	1.8174**	0.0127
Lithologic units/ Cores	61	0.2243	0.0223
Samples/Lithologic units/Cores	63	0.1349	0.0000
Slides/Samples/ Lithologic units/ Cores	126	0.1825	0.1825

Appendicisporites tricornitatus Weyland and Greifeld 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	231		
Cores	1	2.1501**	0.0174
Lithologic units/ Cores	56	0.1959	0.0156
Samples/Lithologic units/Cores	58	0.1336	0.0000
Slides/Samples/ Lithologic units/ Cores	116	0.1422	0.1422

Infraturma TRICRASSATI Dettmann 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	227		
Cores	1	6.9343**	0.0582
Lithologic units/ Cores	55	0.4597	0.0283
Samples/Lithologic units/Cores	57	0.3465	0.0000
Slides/Samples/ Lithologic units/ Cores	114	0.4079	0.4079

Genus Gleicheniidites Ross 1949 ex Delcourt and Sprumont 1955

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	227		
Cores	1	6.3166**	0.0532
Lithologic units/ Cores	55	0.4072	0.0250
Samples/Lithologic units/Cores	57	0.3070	0.0000
Slides/Samples/ Lithologic units/ Cores	114	0.3860	0.3860

Gleicheniidites senonicus Ross 1949 emend. Skarby 1964

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	219		
Cores	1	4.9434**	0.0519
Lithologic units/ Cores	53	0.3875	0.0276
Samples/Lithologic units/Cores	55	0.2773	0.0000
Slides/Samples/ Lithologic units/ Cores	110	0.3499	0.3499

Genus Trilobosporites Pant 1954 ex R. Potonie 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	63		
Cores	1	0.7594*	0.0955
Lithologic units/ Cores	14	0.0428	0.0000
Samples/Lithologic units/Cores	16	0.1094	0.0000
Slides/Samples/ Lithologic units/ Cores	32	0.1094	0.1094

Trilobosporites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	59		
Lithologic units	14	0.0310	0.0000
Samples/Lithologic units	15	0.0333	0.0000
Slides/Samples/ Lithologic units	30	0.0333	0.0333

Camarozonosporites insignis Norris 1967

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	75		
Lithologic units	18	0.0629	0.0000
Samples/Lithologic units	19	0.0658	0.0000
Slides/Samples/ Lithologic units	38	0.0658	0.0658

Infraturma VELATI new Infraturma

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	114.6706	0.0000
Lithologic units/ Cores	62	342.6182**	81.4202
Samples/Lithologic units/Cores	64	16.9375**	6.4297
Slides/Samples/ Lithologic units/ Cores	128	4.0781	4.0781

Applanopsis dampieri (Balme 1957)

Doring 1961

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	123		
Cores	1	0.1614	0.0039
Lithologic units/ Cores	29	0.0756	0.0048
Samples/Lithologic units/Cores	31	0.0565	0.0000
Slides/Samples/ Lithologic units/ Cores	62	0.0726	0.0726

Peromonolites allenensis Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	118.2182	0.0000
Lithologic units/ Cores	62	343.7844**	81.8133
Samples/Lithologic units/Cores	64	16.5312**	6.2578
Slides/Samples/ Lithologic units/ Cores	128	4.0156	4.0156

Genus Uvaesporites Döring 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	199		
Cores	1	0.0359	0.0000
Lithologic units/ Cores	48	0.2727	0.0569
Samples/Lithologic units/Cores	50	0.0450	0.0000
Slides/Samples/ Lithologic units/ Cores	100	0.0850	0.0850

Uvaesporites glomeratus Döring 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	103		
Lithologic units	25	0.0538	0.0000
Samples/Lithologic units	26	0.0577	0.0000
Slides/Samples/ Lithologic units	52	0.0577	0.0577

Uvaesporites cf. *U. pseudocingulatus* Döring 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	199		
Cores	1	0.1688	0.0000
Lithologic units/ Cores	48	0.2287	0.0484
Samples/Lithologic units/Cores	50	0.0350	0.0000
Slides/Samples/ Lithologic units/ Cores	100	0.0550	0.0550

Anteturma POLLENITES R. Potonie 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	2256.5374	0.4717
Lithologic units/ Cores	62	2196.3950	455.3457
Samples/Lithologic units/Cores	64	375.0117	86.7617
Slides/Samples/ Lithologic units/ Cores	128	201.4883	201.4883

Turma ALETES Ibrahim 1933

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	13354.5430**	94.4205
Lithologic units/ Cores	62	1315.9282**	319.7378
Samples/Lithologic units/Cores	64	36.9766**	7.5781
Slides/Samples/ Lithologic units/	128	21.8203	21.8203

Infraturma PSILONAPITI Erdtman 1947

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	12956.8130	92.6091
Lithologic units/ Cores	62	1149.1479**	277.8855
Samples/Lithologic units/Cores	64	37.6057**	9.9336
Slides/Samples/ Lithologic units/ Cores	128	17.7383	17.7383

Taxodiaceaepollenites hiatus (R. Potonié 1931)

Kremp 1949

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	2167.0837**	15.6006
Lithologic units/ Cores	62	178.0004**	41.5880
Samples/Lithologic units/Cores	64	11.6484**	2.1953
Slides/Samples/ Lithologic units/ Cores	128	7.2578	7.2578

Laricoidites magnus (R. Potonié 1931)

R. Potonié, Thomson and Thiergart 1950

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	199		
Cores	1	0.0001	0.0000
Lithologic units/ Cores	48	0.1087	0.0047
Samples/Lithologic units/Cores	50	0.0899	0.0100
Slides/Samples/ Lithologic units/ Cores	100	0.0700	0.0700

Inaperturopollenites dubius (R. Potonié and Venitz 1934)

Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	4053.0444**	28.1950
Lithologic units/ Cores	62	458.1782**	109.8766
Samples/Lithologic units/Cores	64	18.6719*	3.3789
Slides/Samples/ Lithologic units/ Cores	128	11.9141	11.9141

Araucariacites australis Cookson 1947

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	17.1462**	0.1227
Lithologic units/ Cores	60	2.0767**	0.2903
Samples/Lithologic units/Cores	62	0.9153	0.0484
Slides/Samples/ Lithologic units/ Cores	124	0.8185	0.8185

Perinopollenites elatoides Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	3.1297	0.0000
Lithologic units/ Cores	62	15.9566**	3.4208
Samples/Lithologic units/Cores	64	2.2734	0.0000
Slides/Samples/ Lithologic units/ Cores	128	2.2812	2.2812

Infraturma DISACCIATRILETI Leschik 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	1030.2756**	7.5954
Lithologic units/ Cores	62	61.8594**	13.5049
Samples/Lithologic units/Cores	64	7.8398**	2.1094
Slides/Samples/ Lithologic units/ Cores	128	3.6211	3.6211

Genus Cedripites Wodehouse 1933

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	107.9690**	0.8042
Lithologic units/ Cores	61	6.8746**	1.2078
Samples/Lithologic units/Cores	63	2.0437**	0.5556
Slides/Samples/ Lithologic units/ Cores	126	0.9325	0.9325

Cedripites cretaceus Pocock 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	203		
Cores	1	24.2942*	0.1944
Lithologic units/ Cores	49	4.0876**	0.8712
Samples/Lithologic units/Cores	51	1.6029**	0.4314
Slides/Samples/ Lithologic units/ Cores	102	0.7402	0.7402

Cedripites canadensis Pocock 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	8.6160**	0.0621
Lithologic units/ Cores	60	0.9478**	0.1281
Samples/Lithologic units/Cores	62	0.4355	0.0202
Slides/Samples/ Lithologic units/ Cores	124	0.3952	0.3952

Genus Abietineaepollenites R. Potonié 1951

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	164.0010**	1.2182
Lithologic units/ Cores	62	8.6734**	1.3480
Samples/Lithologic units/Cores	64	3.2812**	1.0000
Slides/Samples/ Lithologic units/ Cores	128	1.2812	1.2812

Abietineaepollenites microalatus R. Potonié 1951

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	156.2750**	1.1562
Lithologic units/ Cores	62	8.8562**	1.2072
Samples/Lithologic units/Cores	64	3.2266**	1.0117
Slides/Samples/ Lithologic units/ Cores	128	1.2031	1.2031

Abietineaepollenites microreticulatus Groot and Penny 1960

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	175		
Cores	1	0.0124	0.0000
Lithologic units/ Cores	42	0.2232	0.0302
Samples/Lithologic units/Cores	44	0.1023	0.0000
Slides/Samples/ Lithologic units/ Cores	88	0.1705	0.1705

Alisporites bilateralis Rouse 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	195		
Cores	1	0.1196	0.0000
Lithologic units/ Cores	47	4.0011**	0.8791
Samples/Lithologic units/Cores	49	0.4847	0.0000
Slides/Samples/ Lithologic units/ Cores	98	0.7194	0.7194

Caytonipollenites Cf. C. pallidus (Reissinger 1938)

Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	35		
Cores	1	0.1984	0.0118
Lithologic units/ Cores	7	0.0510	0.0000
Samples/Lithologic units/Cores	9	0.1111	0.0000
Slides/Samples/ Lithologic units/ Cores	18	0.1111	0.1111

Genus Rugubivesiculites Pierce 1961

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	207		
Cores	1	20.3195*	0.1502
Lithologic units/ Cores	50	4.9062**	1.0571
Samples/Lithologic units/Cores	52	0.6779	0.0529
Slides/Samples/ Lithologic units/ Cores	104	0.5721	0.5721

Rugubivesiculites rugosus Pierce 1961

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	155		
Cores	1	8.1442**	0.0921
Lithologic units/ Cores	37	1.0034**	0.1771
Samples/Lithologic units/Cores	39	0.2949	0.0000
Slides/Samples/ Lithologic units/ Cores	78	0.4615	0.4615

Rugubivesiculites woodbinensis Hedlund 1966

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	207		
Cores	1	8.9611	0.0643
Lithologic units/ Cores	50	2.3657**	0.5133
Samples/Lithologic units/Cores	52	0.3125	0.0000
Slides/Samples/ Lithologic units/ Cores	104	0.3894	0.3894

Unidentified Saccate Sporomorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	67		
Lithologic units	16	0.1893	0.0000
Samples/Lithologic units	17	0.2059	0.0441
Slides/Samples/ Lithologic units	34	0.1176	0.1176

Classopollis torosus (Reissinger 1950)

Couper 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	195		
Cores	1	954.7388**	8.5175
Lithologic units/ Cores	47	148.1874**	24.6234
Samples/Lithologic units/Cores	49	49.6939**	23.5051
Slides/Samples/ Lithologic units/ Cores	98	2.6837	2.6837

Turma PLICATES Naumova 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	11075.6450	73.9523
Lithologic units/ Cores	62	1646.7236**	395.4670
Samples/Lithologic units/Cores	64	64.8555**	19.9179
Slides/Samples/ Lithologic units/ Cores	128	25.0195	25.0195

Eucommiidites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	21		
Lithologic units	6	0.0714	0.0000
Samples/Lithologic units	7	0.0171	0.0000
Slides/Samples/ Lithologic units	14	0.1071	0.1071

Infraturma POLYPLICITI Erdtman 1952

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	243		
Cores	1	4.4687	0.0000
Lithologic units/ Cores	59	6.4115**	1.3139
Samples/Lithologic units/Cores	61	1.1557	0.0000
Slides/Samples/ Lithologic units/ Cores	122	1.3607	1.3607

Genus Ephedripites Bolkhovitina 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	243		
Cores	1	6.6454	0.0025
Lithologic units/ Cores	59	6.3357**	1.3390
Samples/Lithologic units/Cores	61	0.9795	0.0000
Slides/Samples/ Lithologic units/ Cores	122	1.2828	1.2828

Ephedripites virginiaensis Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	135		
Cores	1	0.0648	0.0000
Lithologic units/ Cores	32	0.1434	0.0000
Samples/Lithologic units/Cores	34	0.1544*	0.0294
Slides/Samples/ Lithologic units/ Cores	68	0.0956	0.0956

Ephedripites dudarensis Deák 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	243		
Cores	1	7.7601	0.0145
Lithologic units/ Cores	59	5.9924**	1.2768
Samples/Lithologic units/Cores	61	0.8852	0.0000
Slides/Samples/ Lithologic units/ Cores	122	1.1557	1.1557

Ephedripites sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	127		
Cores	1	0.0124	0.0000
Lithologic units/ Cores	30	0.0902	0.0000
Samples/Lithologic units/Cores	32	0.0937**	0.0312
Slides/Samples/ Lithologic units/ Cores	64	0.0312	0.0312

Welwitschiapites virgatus Deák 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	183		
Cores	1	0.8011	0.0089
Lithologic units/ Cores	44	0.0619	0.0000
Samples/Lithologic units/Cores	46	0.0815	0.0000
Slides/Samples/ Lithologic units/ Cores	92	0.0924	0.0924

Infraturma MONOCOLPITI (Wodehouse 1935)

Iversen and Troels-Smith 1950

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	253.5022*	1.5554
Lithologic units/ Cores	62	55.1925**	12.2063
Samples/Lithologic units/Cores	64	6.3672	0.0937
Slides/Samples/ Lithologic units/ Cores	128	6.1797	6.1797

Palmaepollenites tranquillus (R. Potonié 1934)

R. Potonié 1951

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	199		
Cores	1	15.0074	0.0668
Lithologic units/ Cores	48	8.4953**	1.9338
Samples/Lithologic units/Cores	50	0.7599	0.0000
Slides/Samples/ Lithologic units/ Cores	100	0.7999	0.7999

Palmaepollenites ?

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	38.7270	0.1652
Lithologic units/ Cores	62	17.6593**	3.4285
Samples/Lithologic units/Cores	64	3.9453	0.3047
Slides/Samples/ Lithologic units/ Cores	128	3.3359	3.3359

Cycadopites nitidus (Balme 1957) nov. comb.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	20.5417	0.0503
Lithologic units/ Cores	62	14.1261**	2.8752
Samples/Lithologic units/Cores	64	2.6250*	0.4531
Slides/Samples/ Lithologic units/ Cores	128	1.7187	1.7187

Liliacidites dividuus (Pierce 1961) Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	155		
Cores	1	0.3516	0.0000
Lithologic units/ Cores	37	0.8713**	0.1217
Samples/Lithologic units/Cores	39	0.3846	0.0321
Slides/Samples/ Lithologic units/ Cores	78	0.3205	0.3205

Monosulcites chaloneri Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	35		
Cores	1	0.6806*	0.0882
Lithologic units/ Cores	7	0.0536	0.0000
Samples/Lithologic units/Cores	9	0.1667*	0.0556
Slides/Samples/ Lithologic units/ Cores	18	0.0556	0.0556

Infraturma TRIPTYCHITI Naumova 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	8175.5859*	54.1789
Lithologic units/ Cores	62	1267.7639**	305.0229
Samples/Lithologic units/Cores	64	47.6719**	14.2109
Slides/Samples/ Lithologic units/ Cores	128	19.2500	19.2500

Genus Tricolpopollenites Pflug and Thomson

in Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	5116.0469**	36.4246
Lithologic units/ Cores	62	471.9038**	110.9320
Samples/Lithologic units/Cores	64	28.1758**	8.1953
Slides/Samples/ Lithologic units/ Cores	128	11.7852	11.7852

Tricolpopollenites parmularius (R. Potonié 1934)

Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	5.6571	0.0104
Lithologic units/ Cores	61	4.3475**	0.7982
Samples/Lithologic units/Cores	63	1.1548	0.1468
Slides/Samples/ Lithologic units/ Cores	126	0.8611	0.8611

Tricolpopollenites retiformis Pflug and Thomson

in Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	207		
Cores	1	2.4921	0.0000
Lithologic units/ Cores	50	7.7163**	1.5541
Samples/Lithologic units/Cores	52	1.5000	0.0000
Slides/Samples/ Lithologic units/ Cores	104	1.5577	1.5577

Tricolpopollenites minutus Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	1627.0471*	10.5534
Lithologic units/ Cores	62	281.4907**	65.1305
Samples/Lithologic units/Cores	64	20.9687**	7.3242
Slides/Samples/ Lithologic units/ Cores	128	6.3203	6.3203

Tricolpopollenites parvulus Groot and Penny 1960

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	498.2261**	3.6831
Lithologic units/ Cores	62	28.6364**	6.1933
Samples/Lithologic units/Cores	64	3.8633	0.4961
Slides/Samples/ Lithologic units/ Cores	128	2.8711	2.8711

Tricolpopollenites elongatus Groot and Groot 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	238		
Cores	1	5.4011	0.0240
Lithologic units/ Cores	58	2.5409**	0.4894
Samples/Lithologic units/Cores	60	0.5917	0.0000
Slides/Samples/ Lithologic units/ Cores	120	0.7017	0.7017

Genus Retitricolpites van der Hammen 1956

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	79.4465	0.3445
Lithologic units/ Cores	61	36.1357**	7.7670
Samples/Lithologic units/Cores	63	5.0675**	1.4762
Slides/Samples/ Lithologic units/ Cores	126	2.1151	2.1151

Retitricolpites virgeus (Groot, Penny and Groot 1961)

Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	179		
Cores	1	0.1834	0.0000
Lithologic units/ Cores	43	0.5751	0.0313
Samples/Lithologic units/Cores	45	0.4499**	0.1333
Slides/Samples/ Lithologic units/ Cores	90	0.1833	0.1833

Retitricolpites cf. R. georgensis Brenner 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	80.6286	0.3544
Lithologic units/ Cores	61	36.0757**	7.8939
Samples/Lithologic units/Cores	63	4.5000**	1.3175
Slides/Samples/ Lithologic units/ Cores	126	1.8651	1.8651

Genus Tricolpites Erdtman 1947 ex Couper 1953

emend. R. Potonie 1960

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	1094.3059**	8.0581
Lithologic units/ Cores	62	66.8972**	14.4431
Samples/Lithologic units/Cores	64	9.1250	0.5742
Slides/Samples/ Lithologic units/ Cores	128	7.9766	7.9766

Tricolpites microreticulatus

Belsky, Boltenhagen and R. Potonie 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	981.7247**	7.1396
Lithologic units/ Cores	62	71.4316**	16.3362
Samples/Lithologic units/Cores	64	6.0869	0.3370
Slides/Samples/ Lithologic units/ Cores	128	5.4130	5.4130

Tricolpites tienabaensis Jardine and Magloire 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	179		
Cores	1	0.0278	0.0000
Lithologic units/ Cores	43	0.4198	0.0286
Samples/Lithologic units/Cores	45	0.3055	0.0000
Slides/Samples/ Lithologic units/ Cores	90	0.4055	0.4055

Tricolpites wilsonii Kimyai 1966

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	207		
Cores	1	9.3344*	0.0691
Lithologic units/ Cores	50	2.3137**	0.3981
Samples/Lithologic units/Cores	52	0.7212	0.0000
Slides/Samples/ Lithologic units/ Cores	104	1.0673	1.0673

Tricolpites spp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	93.8362	0.5242
Lithologic units/ Cores	62	27.0051**	5.3265
Samples/Lithologic units/Cores	64	5.6992**	1.7031
Slides/Samples/ Lithologic units/ Cores	128	2.2930	2.2930

Genus *Latipollis* Krutzsch 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	557.9231	3.1978
Lithologic units/ Cores	62	150.1982**	36.4568
Samples/Lithologic units/Cores	64	4.3711	0.0000
Slides/Samples/ Lithologic units/ Cores	128	4.7148	4.7148

Latipollis normis Krutzsch 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	82.9493	0.4729
Lithologic units/ Cores	62	22.6590**	5.1364
Samples/Lithologic units/Cores	64	2.1133*	0.3984
Slides/Samples/ Lithologic units/ Cores	128	1.3164	1.3164

Latipollis latis Krutzsch 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	48.7933	0.1971
Lithologic units/ Cores	60	24.4500**	5.8050
Samples/Lithologic units/Cores	62	1.2298	0.0000
Slides/Samples/ Lithologic units/ Cores	124	2.0685	2.0685

Latipollis verrucosus Groot and Groot 1962

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	57.5934	0.3360
Lithologic units/ Cores	62	14.7479**	2.9165
Samples/Lithologic units/Cores	64	3.0820**	0.7383
Slides/Samples/ Lithologic units/ Cores	128	1.6055	1.6055

Infraturma PTYCHOTRIPORITI Naumova 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	751.4707*	4.9947
Lithologic units/ Cores	62	114.6446**	19.9522
Samples/Lithologic units/Cores	64	34.8359**	13.8672
Slides/Samples/ Lithologic units/ Cores	128	7.1016	7.1016

Genus Tricolporopollenites Pflug 1952

ex Thomson and Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	728.6858**	4.9806
Lithologic units/ Cores	62	93.6542**	15.9985
Samples/Lithologic units/Cores	64	29.6602**	11.2852
Slides/Samples/ Lithologic units/ Cores	128	7.0898	7.0898

Tricolporopollenites cf. T. aliquantulus Hedlund 1966

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	251		
Cores	1	245.9856	1.2865
Lithologic units/ Cores	61	81.9624**	17.8898
Samples/Lithologic units/Cores	63	10.4031**	3.3920
Slides/Samples/ Lithologic units/ Cores	126	3.6192	3.6192

Tricolporopollenites sp. 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	464.0627**	3.2185
Lithologic units/ Cores	62	53.7006**	11.2474
Samples/Lithologic units/Cores	64	8.7109**	2.1641
Slides/Samples/ Lithologic units/ Cores	128	4.3828	4.3828

Tricolporopollenites sp. 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	223		
Cores	1	0.4301	0.0000
Lithologic units/ Cores	54	0.5936	0.0390
Samples/Lithologic units/Cores	56	0.4375**	0.0937
Slides/Samples/ Lithologic units/ Cores	112	0.2500	0.2500

Psilatricolporites prolatus Pierce 1961

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	0.8419	0.0000
Lithologic units/ Cores	60	2.7847**	0.5339
Samples/Lithologic units/Cores	62	0.6492**	0.1653
Slides/Samples/ Lithologic units/ Cores	124	0.3185	0.3185

Quercoidites ?

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	159		
Cores	1	0.7042	0.0033
Lithologic units/ Cores	38	0.4471*	0.0602
Samples/Lithologic units/Cores	40	0.2062	0.0000
Slides/Samples/ Lithologic units/ Cores	80	0.3062	0.3062

Unidentified Tricolporate Sporomorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	171		
Cores	1	0.0037	0.0000
Lithologic units/ Cores	41	0.4304	0.0277
Samples/Lithologic units/Cores	43	0.3198**	0.1046
Slides/Samples/ Lithologic units/ Cores	86	0.1105	0.1105

Unidentified Tricolporate Sporomorph 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	131		
Lithologic units	32	0.0800	0.0000
Samples/Lithologic units	33	0.0833**	0.0303
Slides/Samples/ Lithologic units	66	0.0227	0.0227

Unidentified Tricolporate Sporomorph 3

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	139		
Cores	1	0.1019	0.0000
Lithologic units/ Cores	33	0.2510	0.0109
Samples/Lithologic units/Cores	35	0.2071**	0.0714
Slides/Samples Lithologic units/ Cores	70	0.0643	0.0643

Infraturma TRIPORITI Naumova 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	123.8151*	0.7366
Lithologic units/ Cores	62	29.8945**	7.1778
Samples/Lithologic units/Cores	64	1.1836**	0.2539
Slides/Samples/ Lithologic units/ Cores	128	0.6758	0.6758

Genus Sporopollis Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	23.3843	0.1104
Lithologic units/ Cores	62	9.2839**	2.0641
Samples/Lithologic units/Cores	64	1.0273*	0.1719
Slides/Samples/ Lithologic units/ Cores	128	0.6836	0.6836

Sporopollis pseudosporites Pflug 1953

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	183		
Cores	1	0.0051	0.0000
Lithologic units/ Cores	44	0.0409	0.0000
Samples/Lithologic units/Cores	46	0.0435**	0.0109
Slides/Samples/ Lithologic units/ Cores	92	0.0217	0.0217

Sporopollis sp. 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	243		
Cores	1	16.5856	0.0985
Lithologic units/ Cores	59	4.5772**	0.9435
Samples/Lithologic units/Cores	61	0.8033	0.0697
Slides/Samples/ Lithologic units/ Cores	122	0.6639	0.6639

Sporopollis sp. 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	1.0845	0.0000
Lithologic units/ Cores	60	1.9495**	0.3896
Samples/Lithologic units/Cores	62	0.3911	0.0363
Slides/Samples/ Lithologic units/ Cores	124	0.3185	0.3185

Conclavipollis densilatus Kimyai 1966

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	163		
Cores	1	11.8762*	0.1377
Lithologic units/ Cores	39	2.0957**	0.4675
Samples/Lithologic units/Cores	41	0.2256	0.0183
Slides/Samples/ Lithologic units/ Cores	82	0.1890	0.1890

Genus Complexiopollis Krutzsch 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	239		
Cores	1	14.0608	0.0876
Lithologic units/ Cores	58	3.6538**	0.6510
Samples/Lithologic units/Cores	60	1.0499**	0.3875
Slides/Samples/ Lithologic units/ Cores	120	0.2750	0.2750

Complexiopollis praetumescens Krutzsch 1959

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	163		
Cores	1	14.5595*	0.1590
Lithologic units/ Cores	39	2.4575*	0.3171
Samples/Lithologic units/Cores	41	1.1890**	0.4878
Slides/Samples/ Lithologic units/ Cores	82	0.2134	0.2134

Complexiopollis sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	91		
Cores	1	0.0437	0.0000
Lithologic units/ Cores	21	4.0445**	0.0622
Samples/Lithologic units/Cores	23	0.1957	0.0326
Slides/Samples/ Lithologic units/ Cores	46	0.1304	0.1304

Triorites cf. T. edwardsii Cookson and Pike 1954

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	247		
Cores	1	0.6979	0.0030
Lithologic units/ Cores	60	0.3277	0.0144
Samples/Lithologic units/Cores	62	0.2702**	0.0766
Slides/Samples/ Lithologic units/ Cores	124	0.1169	0.1169

Unidentified Triporate Sporomorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	127		
Cores	1	0.2521*	0.0060
Lithologic units/ Cores	30	0.0489	0.0000
Samples/Lithologic units/Cores	32	0.0625	0.0000
Slides/Samples/ Lithologic units/ Cores	64	0.0625	0.0625

Turma JUGATES Erdtman 1943

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	255		
Cores	1	116.0157**	0.8169
Lithologic units/ Cores	62	11.8546**	2.5886
Samples/Lithologic units/Cores	64	1.5000	0.0352
Slides/Samples/ Lithologic units/ Cores	128	1.4297	1.4297

Unidentified Dyad Sporomorph 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	239		
Cores	1	7.3500	0.0349
Lithologic units/ Cores	58	3.1609**	0.5881
Samples/Lithologic units/Cores	60	0.8083*	0.1458
Slides/Samples/ Lithologic units/ Cores	120	0.5167	0.5167

Dicotetradites granulatus Norton in Norton and Hall 1969

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	143		
Cores	1	16.5312	0.0902
Lithologic units/ Cores	34	10.7564**	2.4079
Samples/Lithologic units/Cores	36	1.1250	0.0000
Slides/Samples/ Lithologic units/ Cores	72	1.7083	1.7083

Unidentified Palynomorph 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	95		
Cores	1	0.0000	0.0000
Lithologic units/ Cores	22	0.6061	0.0994
Samples/Lithologic units/Cores	24	0.2083	0.0000
Slides/Samples/ Lithologic units/ Cores	48	0.3542	0.3542

Genus Schizosporis Cookson and Dettmann 1960

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	195		
Cores	1	4.8248	0.0174
Lithologic units/ Cores	47	3.1233**	0.6393
Samples/Lithologic units/Cores	49	0.5663	0.0306
Slides/Samples/ Lithologic units/ Cores	98	0.5051	0.5051

Schizosporis parvus Cookson and Dettmann 1960

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	187		
Cores	1	2.6661	0.0030
Lithologic units/ Cores	45	2.3802**	0.5512
Samples/Lithologic units/Cores	47	0.1755	0.0000
Slides/Samples/ Lithologic units/ Cores	94	0.3670	0.3670

Schizosporis majusculus Hedlund 1966

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	179		
Cores	1	0.2844	0.0000
Lithologic units/ Cores	43	0.9967	0.0797
Samples/Lithologic units/Cores	45	0.6778**	0.2500
Slides/Samples/ Lithologic units/ Cores	90	0.1778	0.1778

Genus Hystrichosphaeridium Deflandre 1937 emend. Eisenack 1958

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	211		
Cores	1	135.1915*	1.0403
Lithologic units/ Cores	51	26.8466**	6.5300
Samples/Lithologic units/Cores	53	0.7264	0.0000
Slides/Samples/ Lithologic units/ Cores	106	0.9906	0.9906

Hystrichosphaeridium tubiferum (Ehrenberg 1838) Deflandre 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	155		
Cores	1	19.9694	0.1689
Lithologic units/ Cores	37	7.4970**	1.6755
Samples/Lithologic units/Cores	39	0.7949	0.0000
Slides/Samples/ Lithologic units/ Cores	78	0.8205	0.8205

Hystrichosphaeridium sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	195		
Cores	1	117.4264**	1.1491
Lithologic units/ Cores	47	10.4920**	2.4750
Samples/Lithologic units/Cores	49	0.5918	0.0000
Slides/Samples/ Lithologic units/ Cores	98	1.0918	1.0918

Unidentified Dinophyceae Cyst 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	91		
Cores	1	0.3758	0.0000
Lithologic units/ Cores	21	0.6633	0.0000
Samples/Lithologic units/Cores	23	0.7283**	0.3261
Slides/Samples/ Lithologic units/ Cores	46	0.0761	0.0761

Genus Micrhystridium Deflandre 1937

emend. Downie and Sarjeant 1963

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	199		
Cores	1	464.8914*	3.8295
Lithologic units/ Cores	48	87.4594**	19.4661
Samples/Lithologic units/Cores	50	9.5950**	3.6000
Slides/Samples/ Lithologic units/ Cores	100	2.3950	2.3950

Micrhystridium piliferum Deflandre 1937

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	179		
Cores	1	4.3789	0.0022
Lithologic units/ Cores	43	4.1842**	0.8697
Samples/Lithologic units/Cores	45	0.7056*	0.1389
Slides/Samples/ Lithologic units/ Cores	90	0.4278	0.4278

Micrhystridium fragile Deflandre 1947

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	187		
Cores	1	228.6847**	2.1198
Lithologic units/ Cores	45	31.6760**	7.1331
Samples/Lithologic units/Cores	47	3.1436**	1.1649
Slides/Samples/ Lithologic units/ Cores	94	0.8138	0.8138

Micrhystridium sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	175		
Cores	1	77.3335*	0.7042
Lithologic units/ Cores	42	15.8799**	3.4288
Samples/Lithologic units/Cores	44	2.1648*	0.4602
Slides/Samples/ Lithologic units/ Cores	88	1.2443	1.2443

Baltisphaeridium sp.

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	139		
Cores	1	2.5433	0.0000
Lithologic units/ Cores	33	3.6078**	0.6752
Samples/Lithologic units/Cores	35	0.9071*	0.2071
Slides/Samples/ Lithologic units/ Cores	70	0.4929	0.4929

Metaleiofusa diagonalis Wall 1965

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	179		
Cores	1	7.9824**	0.0874
Lithologic units/ Cores	43	0.5875**	0.0802
Samples/Lithologic units/Cores	45	0.2667	0.0000
Slides/Samples/ Lithologic units/ Cores	90	0.2667	0.2667

Unidentified Acritarch 1

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	103		
Cores	1	2.1987	0.0215
Lithologic units/ Cores	24	1.0851**	0.2112
Samples/Lithologic units/Cores	26	0.2404	0.0385
Slides/Samples/ Lithologic units/ Cores	52	0.1635	0.1635

Unidentified Acritarch 2

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	123		
Cores	1	0.1646	0.0015
Lithologic units/ Cores	29	0.0799	0.0000
Samples/Lithologic units/Cores	31	0.0968	0.0161
Slides/Samples/ Lithologic units/ Cores	62	0.0645	0.0645

Unidentified Acritarch 3

SOURCE OF VARIATION	DEGREES OF FREEDOM	MEAN SQUARE	VARIANCE COMPONENT
Total	119		
Cores	1	1.5787	0.0098
Lithologic units/ Cores	28	0.9924**	0.1898
Samples/Lithologic units/Cores	30	0.2333	0.0333
Slides/Samples/ Lithologic units/ Cores	60	0.1667	0.1667

APPENDIX D

PREDICTION EQUATIONS

For each taxon whose vertical range encompassed five or more samples in a given core, the frequency of occurrence of that taxon was analyzed according to a backward regression technique in that core. The prediction equations which resulted from this technique are presented in this Appendix.

The initial regression model applied to these data included the effects of changes in depth (represented by the linear, quadratic and cubic polynomials), median grain size and sorting coefficient, and can be expressed as:

$$Y_{ij} = \alpha + \beta_1 d_i + \beta_2 d_i^2 + \beta_3 d_i^3 + \beta_4 m_i + \beta_5 s_i + \varepsilon_{ij}$$

where,

Y_{ij} = the frequency of occurrence of a taxon on the jth slide made from the ith sample,

α = the Y-intercept (the value of the dependent variable when depth, median grain size and sorting coefficient are all zero),

β_1 = the partial regression coefficient of frequency of occurrence on the linear response of depth (d),

β_2 = the partial regression coefficient of frequency of occurrence on the quadratic response of depth (d^2),

β_3 = the partial regression coefficient of frequency of occurrence on the cubic response of depth (d^3),

β_4 = the partial regression coefficient of frequency of occurrence on median grain size (m),

β_5 = the partial regression coefficient of frequency of occurrence on sorting coefficient (s),

d_i = the depth of the ith sample,

m_i = the median grain size of the ith sample,

s_i = the sorting coefficient of the ith sample,

$_{ij}$ = random error, NID (0, 0^2).

Tests of significance were performed on each of the five partial regression coefficients included in the initial model. These tests were performed at the .05 level of probability. When one or more of the coefficients was determined nonsignificant, the least significant term in the expression was deleted, and the response of frequency of occurrence to changes in the remaining independent variables was determined. This deletion process was repeated until the remaining terms were all significant. These remaining terms were the only ones which significantly affected the manner in which the response surface fitted the data. The calculations required to obtain the partial regression coefficients, and evaluate their significance are explained in Snedecor and Cochran (1967, Chapter 13).

Along with each prediction equation, the ratio of the variation accounted for by that prediction equation to the total variation (R^2) is included.

Anteturma SPORITES H. Potonié 1893

Webb No. 1: $R^2 = .3663$

$Y = 41.7873 - 0.7089d + 0.00302721d^2 - 0.0000034111d^3 + 3.1133s$

Boykin No. 2: $R^2 = .0560$

$Y = -236.3260 + 2.3574d - 0.00674162d^2 + 0.000006246d^3$

Turma CHARAGMES Hart (in press)

Webb No. 1: $R^2 = .4291$

$Y = 31.7837 - 0.4321d + 0.00162545d^2 - 0.000001670d^3 + 1.6401s$

Boykin No. 2: $R^2 = .3757$

$Y = -2.2549 + 0.0758d - 39.7285m$

Subuturma TRILETES (Reinch 1881)

R. Potonié and Kremp 1954

Webb No. 1: $R^2 = .4133$

$Y = 27.0705 - 0.3822d + 0.00141697d^2 - 0.000001521d^3 + 1.6767s$

Boykin No. 2: $R^2 = .3260$

$Y = 0.1365 + 0.0655d - 37.7200m$

Infraturma LAEVIGATI (Bennie and Kidston 1886)

R. Potonié 1956

Webb No. 1: $R^2 = .2695$

$Y = -5.7414 + 0.00015963d^2 - 0.000000223d^3 + 1.0196s$

Boykin No. 2: None.

Calamospora mesozoica Couper 1958

Webb No. 1: $R^2 = .1273$

$Y = 0.3819 + 0.00000840d^2 - 3.8057m$

Boykin No. 2: $r^2 = .0544$

$Y = 1.5095 - 0.00000589d^2$

Triplanosporites sinuosus Pflug 1952

Webb No. 1: $R^2 = .2171$

$Y = 6.8497 - 0.0891d + 0.00035894d^2 - 0.000000456d^3 + 0.0507s$

Boykin No. 2: $R^2 = .1988$

$Y = 6.2647 - 0.0280d + 0.00003369d^2 - 0.0849s$

Genus Cyathidites Couper 1953

Webb No. 1: $R^3 = .2965$

$Y = 2.0952 + 0.00003070d^2 - 16.6274m$

Boykin No. 2: $r^2 = .0382$

$Y = 5.5344 + 0.0101d$

Cyathidites australis Couper 1953

Webb No. 1: $R^2 = .1887$

$Y = 0.5525 + 0.00001111d^2 - 7.0260m$

Boykin No. 2: $R^2 = .1508$

$Y = 5.9687 - 0.00008566d^2 + 0.000000134d^3$

Cyathidites minor Couper 1953

Webb No. 1: $R^2 = .2174$

$Y = -0.2215 + 0.00001939d^2 + 0.2607s$

Boykin No. 2: $R^2 = .1899$

$Y = -13.1404 + 0.1012d - 0.00011523d^2$

Divisisporites sp.

Webb No. 1: $R^2 = .0613$

$Y = 0.0999 - 0.00000341d^2 + 0.000000008d^3$

Boykin No. 2: No prediction equation.

Genus Undulatisporites Pflug in Thomson and Pflug 1953

Webb No. 1: $R^2 = .2317$

$Y = 3.9731 - 0.0244d + 0.00003703d^2$

Boykin No. 2: No prediction equation.

Undulatisporites undulapolus Brenner 1963

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Undulatisporites sp.

Webb No. 1: $R^2 = .1641$

$Y = 3.2090 - 0.0194d + 0.00002910d^2$

Boykin No. 2: No prediction equation.

Stereisporites antiquasporites (Wilson and Webster 1946) Dettmann 1963

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Leiotriletes paramaximus Krutzsch 1959

Webb No. 1: $R^2 = .1602$

$Y = 0.4853 - 0.0044d + 0.00000755d^2 + 0.0555s$

Boykin No. 2: $R^2 = .1928$

$Y = -0.8772 + 0.000000018d^3 + 3.7744m$

Genus Deltoidospora Miner 1935 emend. R. Potonié 1956

Webb No. 1: $R^2 = .1322$

$Y = -4.2508 + 0.0228d - 0.0000320d^2 + 4.6827m + 0.2428$

Boykin No. 2: $R^2 = .0696$

$Y = -0.5909 + 0.0047d + 0.1122s$

Deltoidospora hallii Miner 1935

Webb No. 1: $R^2 = .0551$

$Y = -0.5259 + 0.00002645d^2 - 0.000000050d^3 + 0.0982s$

Boykin No. 2: $R^2 = .0696$

$Y = 0.4533 + 0.000000012d^3 + 0.1072s$

Deltoidospora juncta (Kara-Murza 1961) Singh 1964

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .1037$

$Y = 4.9447 - 0.0309d + 0.00004807d^2$

Genus Todisporites Couper 1958

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .1083$

$$Y = -48.7369 + 0.4272d - 0.00121093d^2 + 0.000001121d^3$$

Todisporites minor Couper 1958

Webb No. 1: $R^2 = .1525$

$$Y = -0.2262 + 0.00000127d^2 + 0.0793s$$

Boykin No. 2: $R^2 = .1297$

$$Y = -43.0501 + 0.3743d - 0.00104745d^2 + 0.00000095d^3$$

Todisporites scabratus Groot and Groot 1962

Webb No. 1: $R^2 = .2007$

$$Y = 16.7382 - 0.1046d - 0.00016168d^2$$

Boykin No. 2: $r^2 = .1043$

$$Y = -0.6603 + 0.00000492d^2$$

Dictyophyllidites cf. D. harrisii Couper 1958

Webb No. 1: $R^2 = .1020$

$$Y = 0.4459 - 0.00003034d^2 + 0.000000092d^3$$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin No. 2 core hole.

Plicifera delicata (Bolkhovitina 1953) Bolkhovitina 1967

Webb No. 1: $R^2 = .1657$

$$Y = -1.4615 + 0.0241d - 0.0000937 1d^2 + 0.000000106d^3$$

Boykin No. 2: No prediction equation.

Unidentified Laevigate Sporomorph 2

Webb No. 1: $R^2 = .0833$

$Y = -0.1828 + 0.000000003d^3 + 0.0522s$

Boykin No. 2: $R^2 = .2540$

$Y = -26.5087 + 0.2393 - 0.00070317d^2 + 0.000000675d^3$

Infraturma APICULATI (Bennie and Kidston 1886)

R. Potonié 1956

Webb No. 1: $R^2 = .2509$

$Y = 14.7809 - 0.1673d + 0.00058256d^2 - 0.000000594d^3$

Boykin No. 2: $r^2 = .1371$

$Y = 0.8104 + 0.000000033d^3$

Trilites sp.

Webb No. 1: $R^2 = .2423$

$Y = 5.4490 - 0.0721d + 0.00027052d^2 - 0.000000292d^3$
$+ 0.1073s$

Boykin No. 2: $r^2 = .0625$

$Y = -0.5502 + 0.0068d$

Genus *Acanthotriletes* Naumova 1937

Webb No. 1: $R^2 = .2790$

$Y = -7.0944 + 0.0978d - 0.00041463d^2 + 0.000000551d^3$

Boykin No. 2: $r^2 = .1897$

$Y = -0.4322 + 0.00000657d^2$

Acanthotriletes levidensis Balme 1957

Webb No. 1: $R^2 = .0845$

$Y = 0.9515 - 0.0078d + 0.00001570d^2$

Boykin No. 2: No prediction equation.

Acanthotriletes varispinosus Pocock 1962

Webb No. 1: $R^2 = .3052$

$Y = 11.0445 - 0.0497d + 0.000000148d^3$

Boykin No. 2: $r^2 = .0798$

$Y = 0.4757 - 0.481s$

Acanthotriletes sp. 1

Webb No. 1: No prediction equation.

Boykin No. 2: $r^2 = .1301$

$Y = -0.1099 + 2.9869m$

Acanthotriletes sp. 2

Webb No. 1: $R^2 = .4233$

$Y = -12.1486 + 0.1741d - 0.0007483d^2 + 0.000000962d^3 + 10.6754m$

Boykin No. 2: No prediction equation.

Unidentified Apiculate Sporomorph 1

Webb No. 1: $R^2 = .1639$

$Y = -0.6408 + 0.0095d - 0.00004002d^2 + 0.000000051d^3$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin No. 2 core hole.

Unidentified Apiculate Sporomorph 2

Webb No. 1: $R^2 = .1442$

$$Y = 0.4649 - 0.00002059d^2 + 0.000000053d^3$$

Boykin No. 2: $R^2 = .4195$

$$Y = -25.4379 + 0.2384d - 0.00072778d^2 + 0.000000725d^3$$

Infraturma MURONATI R. Potonié and Kremp 1954

Webb No. 1: $R^2 + .2486$

$$Y = -1.7359 + 0.00002058d^2 + 0.5727s$$

Boykin No. 2: $R^2 = .4365$

$$Y = 0.3060 + 0.00005602d^2 - 30.1828m$$

Genus Cicatricosisporites R. Potonié and Gelletich 1933

Webb No. 1: $R^2 = .2252$

$$Y = 1.0735 + 0.00001384d^2 - 7.9735m$$

Boykin No. 2: $R^2 = .3837$

$$Y = 0.6867 + 0.00004215d^2 - 25.4585m$$

Cicatricosisporites dorogensis R. Potonié and Gelletich 1933

Webb No. 1: $R^2 = .0877$

$$Y = 3.4429 - 0.0441d + 0.0016721d^2 - 0.000000184d^3 + 0.1188s$$

Boykin No. 2: $R^2 = .3648$

$$Y = 8.4078 - 0.0508d + 0.0009394d^2 - 12.8845m$$

Cicatricosisporites australiensis (Cookson 1953)

R. Potonié 1956

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Cicatricosisporites carlylensis Pocock 1962

Webb No. 1: $R^2 = .4096$

$Y = -0.8794 + 0.0319d - 0.00015929d^2 + 0.000000214d^3$

Boykin No. 2: $r^2 = .0704$

$Y = -0.1424 + 0.00000326d^2$

Cicatricosisporites venustus Deák 1963

Webb No. 1: $r^2 = .0660$

$Y = 0.1427 + 0.00000330d^2$

Boykin No. 2: $r^2 = .0573$

$Y = 2.3172 - 8.0789m$

Cicatricosisporites lucifer Hughes and Moody-Stuart 1967

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Cicatricosisporites coconinoensis Agasie 1969

Webb No. 1: $R^2 = .3785$

$Y = -1.1555 + 0.0167d - 0.00007419d^2 + 0.000000099d^3$

$+ 0.0333s$

Boykin No. 2: No prediction equation.

Lygodioisporites cf. L. perverrucatus Couper 1958

Webb No. 1: $R^2 = .0896$

$Y = 2.0635 - 0.0187d + 0.00004149d^2$

Chomotriletes fragilis Pocock 1962

Webb No. 1: No specimens assigned to this species were recorded from Webb No. 1 core hole.

Boykin No. 2: No prediction equation.

Rugulatisporites caperatus van Hoeken-Klinkenberg 1964

Webb No. 1: $R^2 = .1336$

$Y = 1.3488 - 0.0118d + 0.00002105d^2 + 0.0758s$

Boykin No. 2: No prediction equation.

Microreticulatisporites pseudofoveolatus Deák 1965

Webb No. 1: $R^2 = .1683$

$Y = 0.0903 - 0.00000623d^2 + 0.000000014d^3 + 0.0208s$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin No. 2 core hole.

Genus Foveotriletes van der Hammen 1954 ex R. Potonié 1956

Webb No. 1: $R^2 = .1186$

$Y = -2.6809 + 0.00005733d^2 - 0.000000099d^3 + 3.9096m$

Boykin No. 2: No prediction equation.

Foveotriletes subtriangularis Brenner 1963

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Klukisporites pseudoreticulatus Couper 1958

Webb No. 1: $R^2 = .5321$

$$Y = -2.0209 + 0.0329d - 0.00013799d^2 + 0.000000170d^3$$

Boykin No. 2: $r^2 = .0749$

$$Y = -0.0799 + 0.000000004d^3$$

Genus Retitriletes Pierce 1961

Webb No. 1: $R^2 = .3973$

$$Y = 7.0530 - 0.0795d + 0.00026923d^2 - 0.000000288d^3 + 0.1022s$$

Boykin No. 2: $r^2 = .0800$

$$Y = -0.1304 + 0.000000006d^3$$

Retitriletes pluricellulus Pierce 1961

Webb No. 1: No specimens assigned to this species were recorded from the Webb No. 1 core hole.

Boykin No. 2: $R^2 = .1710$

$$Y = 8.6584 - 0.0469d + 0.00006333d^2$$

Retitriletes cenomanianus Agasie 1969

Webb No. 1: $R^2 = .3973$

$$Y = 7.0530 - 0.0795d + 0.00026923d^2 - 0.000000288d^3 + 0.1022s$$

Boykin No. 2: $r^2 = .0646$

$$Y = -0.1136 + 0.000000005d^3$$

Costatoperforosporites spp.

Webb No. 1: $R^2 = .1833$

$Y = -1.3258 + 0.220d - 0.00009200d^2 + 0.000000114d^3$

Boykin No. 2: $r^2 = .0646$

$Y = -0.1009 + 0.00000199d^2$

Unidentified Muronate Sporomorph 1

Webb No. 1: $R^2 = .1016$

$Y = 0.4634 - 0.00003446d^2 + 0.000000111d^3$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin No. 2 core hole.

Unidentified Muronate Sporomorph 2

Webb No. 1: No specimens assigned to this species were recorded from the Webb No. 1 core hole.

Boykin No. 2: $R^2 = .2292$

$Y = 3.4578 - 0.00007049d^2 + 0.000000121d^3$

Unidentified Muronate Sporomorph

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Unidentified Muronate Sporomorph

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .3275$

$Y = 310.3855 - 1.5914d + 0.00283960d^2$

Subturma MONOLETES Ibrahim 1933

Webb No. 1: $r^2 = .1478$

$Y = -0.4079 + 0.00001058d^2$

Boykin No. 2: $r^2 = .2755$

$Y = -0.6149 + 0.00001314d^2$

Infraturma LAEVIGATOMONOLETI Dybova and Jackowicz 1957

Webb No. 1: $r^2 = .1470$

$Y = -0.4103 + 0.00001054d^2$

Boykin No. 2: $r^2 = .2836$

$Y = -0.6748 + 0.00001340d^2$

Genus Laevigatosporites Ibrahim 1932

emend. Schopf, Wilson and Bentall 1944

Webb No. 1: $R^2 = .3239$

$Y = 0.4010 - 0.00001631d^2 + 0.000000042d^3$

Boykin No. 2: $R^2 = .2733$

$Y = 36.1697 - 0.3175d + 0.000090344d^2 - 0.000000815d^3$

Laevigatosporites ovatus Wilson and Webster 1946

Webb No. 1: $R^2 = .3411$

$Y = 1.0085 - 0.0057d + 0.000000027d^3$

Boykin No. 2: $R^2 = .2410$

$Y = 32.2588 - 0.2843d + 0.00081354d^2 - 0.000000738d^3$

Laevigatosporites albertensis Rouse 1957

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Monolites intragranulosus Singh, Srivastava and Roy 1963

Webb No. 1: $R^2 = .7620$

$Y = 531.3630 - 2.6643d + 0.00330869d^2 + 11.6910m$

Boykin No. 2: $R^2 = .1951$

$Y = 12.3144 - 0.0638d + 0.00008248d^2$

Verrucatosporites pseudoreticulatus Hedlund 1966

Webb No. 1: No prediction equation.

Boykin No. 2: $r^2 = .0654$

$Y = -0.0452 + 1.1900m$

Subturma ZONOTRILETES Valts 1955

Webb No. 1: $R^2 = .1419$

$Y = 29.4770 - 0.3181d + 0.00103459d^2 - 0.00000098d^3$

Boykin No. 2: $r^2 = .2215$

$Y = 0.0179 + 0.000000025d^3$

Infraturma ZONATI R. Potonié and Kremp 1954

Webb No. 1: $r^2 = .0991$

$Y = -1.5699 + 0.00003064d^2$

Boykin No. 2: $R^2 = .2647$

$Y = 26.0187 - 0.1339d + 0.00018083d^2 - 7.7510m - 0.1307s$

Cirratriradites teter Norris 1967

Webb No. 1: $R^2 = .6396$

$$Y = -1240.7947 + 10.8948d - 0.03156016d^2 + 0.000030052d^3 + 43.9244m$$

Boykin No. 2: $R^2 = .2647$

$$Y = 26.0187 - 0.1339d + 0.00018083d^2 - 7.7510m - 0.1307s$$

Rouseisporites sp.

Webb No. 1: $R^2 = .0902$

$$Y = 0.3469 - 0.00002267d^2 + 0.000000068d^3$$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin core hole.

Unidentified Zonate Sporomorph 3

Webb No. 1: $R^2 = .1018$

$$Y = 0.1389 - 0.0011d + 0.000000004d^3 + 0.0190s$$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin core hole.

Infraturma CINGULATI R. Potonie and Kremp 1954

Webb No. 1: $R^2 = .2698$

$$Y = 2.3458 - 0.0201d + 0.00003721d^2 + 0.0741s$$

Boykin No. 2: $r^2 = .3640$

$$Y = -0.1427 + 3.7939m$$

Genus Cingulatisporites Thomson in Thomson and Pflug 1953 emend. R. Potonié 1956

Webb No. 1: $R^2 = .0584$

$Y = 0.4176 - 0.0033d + 0.00000631d^2$

Boykin No. 2: $= .1717$

$Y = -0.1098 + 2.1911m$

Cingulatisporites levispeciosus Pflug 1953

Webb No. 1: No prediction equation.

Boykin No. 2: $r^2 = .1717$

$Y = -0.1098 + 2.1911m$

Unidentified Cingulate Sporomorph 1

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .5207$

$Y = 128.2215 - 0.5540d + 0.00059816d^2$

Unidentified Cingulate Sporomorph 2

Webb No. 1: No specimens assigned to this species were recorded from the Webb core hole.

Boykin No. 2: $R^2 = .1664$

$Y = 6.8962 - 0.0330d + 0.00003919d^3$

Genus Appendicisporites Weyland and Kreiger 1953

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Appendicisporites tricornitatus Weyland and Greifeld 1953

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Infraturma TRICRASSATI Dettmann 1963

Webb No. 1: $R^2 = .0557$

$Y = 0.3451 - 0.00000970d^2 + 0.000000021d^3$

Boykin No. 2: $r^2 = .0436$

$Y = 0.0051 + 0.00000370d^2$

Genus Gleicheniidites Ross 1949 ex Delcourt and Sprumont 1955 emend. Skarby 1964

Webb No. 1: $r^2 = .0470$

$Y = 0.0176 + 0.000000003d^3$

Boykin No. 2: No prediction equation.

Gleicheniidites senonicus Ross 1949

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Genus Trilobosporites Pant 1954 ex R. Potonié 1956

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Trilobosporites sp.

Webb No. 1: No specimens assigned to this species were recorded from the Webb core hole.

Boykin No. 2: $R^2 = .0843$

$Y = 4.2168 - 0.0223d + 0.00002939d^2$

Camarozonosporites insignis Norris 1967

Webb No. 1: $R^2 = .0916$

$Y = 1.3810 - 0.0125d + 0.00002753d^2$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin No. 2 core hole.

Infraturma VELATI new Infraturma

Webb No. 1: $R^2 = .2615$

$Y = -13.4646 + 0.00045718d^2 - 0.000000184d^3 + 1.3508s$

Boykin No. 2: $R^2 = .5149$

$Y = -381.8362 + 3.6032d - 0.01051958d^2 + 0.0000097 44d^3$

Peromonolites allenensis Brenner 1963

Webb No. 1: $R^2 = .2611$

$Y = -13.4997 + 0.00045939d^2 - 0.000000818d^3 + 1.3198s$

Boykin No. 2: $R^2 = .5020$

$Y = -374.4807 + 3.5377d - 0.01033485d^2 + 0.000009577d^3$

Applanopsis dampieri (Balme 1957)

Döring 1961

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Genus Uvaesporites Döring 1965

Webb No. 1: $R^2 = .0971$

$Y = 0.8721 = 0.0063d + 0.00001106d^2$

Boykin No. 2: $R^2 = .3295$

$Y = 64.8422 - 0.4824d + 0.00119174d^2 - 0.000000974d^3 - 0.0441s$

Uvaesporites glomeratus Döring 1965

Webb No. 1: $R^2 = .0627$

$Y = 0.7585 - 0.0059d - 0.00001124d^2$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin core hole.

Uvaesporites cf. U. pseudocingulatus Döring 1965

Webb No. 1: $R^2 = .1282$

$Y = 0.2042 - 0.00000843d^2 + 0.000000019d^3$

Boykin No. 2: $R^2 = .3295$

$Y = 64.8422 - 0.4824d + 0.00119174d^2 - 0.000000975d^3 - 0.0441s$

Anteturma POLLENITES R. Potonié 1937

Webb No. 1: $R^2 = .4507$

$Y = -53.1052 + 0.00227532d^2 - 0.000003314d^3 + 5.6741s$

Boykin No. 2: $R^2 = .1441$

$Y = 226.4908 - 0.6613d + 0.00091398d^2 - 47.0445m$

Turma ALETES Ibrahim 1933

Webb No. 1: $R^2 = .3381$

$Y = -42.9944 + 0.3684d - 0.00038756d^2$

Boykin No. 2: $R^2 = .2486$

$Y = 72.0619 - 0.00051579d^2 + 0.000000764d^3$

Infraturma PSILONAPITI Erdtman 1947

Webb No. 1: $R^2 = .3316$

$Y = -38.8167 + 0.3355d - 0.00034969d^2$

Boykin No. 2: $R^2 = .1516$

$Y = 63.3062 - 0.00039676d^2 + 0.000005936d^3$

Taxodiaceaepollenites hiatus (R. Potonie 1934)
Kremp 1949

Webb No. 1: $R^2 = .2545$

$Y = -0.6084 + 0.00022665d^2 - 0.00000324d^3$

Boykin No. 2: $r^2 = .1946$

$Y = 21.2210 - 0.00004004d^2$

Laricoidites magnus (R. Potonie 1931)
R. Potonie, Thomson and Thiergart 1950

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Inaperturopollenites dubius (R. Potonie and Venitz 1934)
Thomson and Pflug 1953

Webb No. 1: $R^2 = .3050$

$Y = -23.0690 + 0.2009d - 0.00020750d^2$

Boykin No. 2: $r^2 = .0596$

$Y = 28.4346 - 0.00002935d^2$

Araucariacites australis Cookson 1947

Webb No. 1: $R^2 = .1753$

$Y = 3.1858 - 0.0387d + 0.00013140d^2 - 0.000000134d^3 + 0.1169s$

Boykin No. 2: $r^2 = .0646$

$Y = -0.0862 + 0.00000651d^2$

Perinopollenites elatoides Couper 1958

Webb No. 1: $R^2 = .1877$

$Y = -3.1790 + 0.0218d - 0.000000039d^3$

Boykin No. 2: $R^2 = .3927$

$Y = -60.1548 + 0.5957d - 0.001778d^2 + 0.000001669d^3$

Infraturma DISACCIATRILETI Leschik 1956

Webb No. 1: $R^2 = .3664$

$Y = 0.1548 + 0.00002723d^2 - 8.3401m$

Boykin No. 2: $R^2 = .6540$

$Y = 422.1064 - 3.8991d + 0.01151611d^2 - 0.00001090d^3$

Genus Cedripites Wodehouse 1933

Webb No. 1: $R^2 = .1228$

$Y = -0.1848 + 0.0033d - 2.7457m$

Boykin No. 2: $R^2 = .4928$

$$Y = 128.0894 - 1.1763d + 0.00345559d^2 - 0.000003249d^3$$

Cedripites cretaceus Pocock 1962

Webb No. 1: $r^2 = .0837$

$$Y = 1.2995 - 5.2070m$$

Boykin No. 2: $R^2 = .4618$

$$Y = 103.1933 - 0.9498d + 0.00279622d^2 - 0.000002639d^3 + 11.6135m + 0.1039s$$

Cedripites canadensis Pocock 1962

Webb No. 1: $R^2 = .2065$

$$Y = -1.1095 + 0.0164d - 0.00007042d^2 + 0.000000092d^3$$

Boykin No. 2: $R^2 = .1746$

$$Y = 30.1659 - 0.2687d + 0.00077490d^2 - 0.000000715d^3$$

Genus Abietineaepollenites R. Potonié 1951

Webb No. 1: $R^2 = .2350$

$$Y = 4.1836 - 0.0466d + 0.00016448d^2 - 0.000000163d^3$$

Boykin No. 2: $R^2 = .3104$

$$Y = 156.8112 - 1.4377d + 0.00423626d^2 - 0.000004020d^3 + 21.2873m + 0.1927s$$

Abietineaepollenites microalatus R. Potonié 1951

Webb No. 1: $R^2 = .2332$

$$Y = 6.1897 - 0.0677d + 0.00023331d^2 - 0.000000234d^3$$

Boykin No. 2: $R^2 = .3014$

$$Y = 150.4900 - 1.3796d + 0.00406431d^2 - 0.0000038 54d^3 + 18.8989m + 0.7930s$$

Abietineaepollenites microreticulatus Groot and Penny 1960

Webb No. 1: $R^2 = .1577$

$$Y = -1.4714 + 0.0246d - 0.00009689d^2 + 0.0000001 10d^3$$

Boykin No. 2: $r^2 = .0626$

$$Y = -0.0981 + 2.6521m$$

Alisporites bilateralis Rouse 1959

Webb No. 1: $R^2 = .5348$

$$Y = 5.1084 - 0.00012399d^2 + 0.000000233d^3$$

Boykin No. 2: $r^2 = .1793$

$$Y = -0.4393 + 0.000000904d^2$$

Caytonipollenites cf. C. pallidus (Reissinger 1938) Couper 1958

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Genus Rugubivesiculites Pierce 1961

Webb No. 1: $R^2 = .4762$

$$Y = 5.7759 - 0.0209d + 0.000000063d^3 - 0.1121s$$

Boykin No. 2: $R^2 = .5143$

$$Y = 92.6497 - 0.8651d + 0.00257150d^2 - 0.000002447d^3 + 13.4474m + 0.0819s$$

Rugubivesiculites rugosus Pierce 1961

Webb No. 1: $R^2 = .3922$

$Y = 1.4428 - 0.00003630d^2 + 0.000000069d^3$

Boykin No. 2: $R^2 = .1944$

$Y = 98.1951 - 0.7668d + 0.00197410d^2 - 0.000001664d^3$

Rugubivesiculites woodbinensis Hedlund 1966

Webb No. 1: $R^2 = .2317$

$Y = 0.3907 + 0.000000007d^3 - 4.1265m$

Boykin No. 2: $R^2 = .4222$

$Y = 64.1293 - 0.5983d + 0.00178932d^2 - 0.000001720d^3 + 10.5306m$

Unidentified Saccate Sporomorph 1

Webb No. 1: No specimens assigned to this species were recorded from the Webb core hole.

Boykin No. 2: No prediction equation.

Classopollis torosus (Reissinger 1950) Couper 1958

Webb No. 1: $R^2 = .1694$

$Y = 5.6825 - 0.0402d + 0.00006281d^2 + 0.5753s$

Boykin No. 2: $R^2 = .3746$

$Y = 362.4639 - 3.5133d + 0.01088421d^2 - 0.000010765d^3 + 58.9829m$

Turma PLICATES Naumova 1937

Webb No. 1: $R^2 = .4479$

$Y = -37.3167 + 0.00122354d^2 - 0.000001824d^3 + 4.3545s$

Boykin No. 2: $R^2 = .0796$

$Y = 67.4176 - 0.00054787d^2 + 0.000001005d^3$

Eucommiidites sp.

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .0556$

$Y = 0.3648 - 0.0000934d^2 + 0.000000018d^3$

Infraturma POLYPLICITI Erdtman 1952

Webb No. 1: $R^2 = .1548$

$Y = -1.9486 + 0.00006841d^2 - 0.000000110d^3 + 0.2028s$

Boykin No. 2: $r^2 = .0845$

$Y = 2.7381 - 0.0046d$

Genus Ephedripites Bolkhovitina 1953

Webb No. 1: $R^2 = .1480$

$Y = -1.8771 + 0.00006850d^2 - 0.000000116d^3 + 0.1823s$

Boykin No. 2: $r^2 = .1131$

$Y = 1.9330 - 0.0000711d^2$

Ephedripites virginiaensis Brenner 1963

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Ephedripites dudarensis Deak 1965

Webb No. 1: $R^2 = .1440$

$Y = -1.7849 + 0.00006450d^2 - 0.000000110d^3 + 0.1771s$

Boykin No. 2: $r^2 = .1504$

$Y = 2.9210 - 0.0056d$

Ephedripites sp.

Webb No. 1: $R^2 = .1131$

$Y = 1.3657 - 0.00002862d^2 + 0.000000050d^3$

Boykin No. 2: $R^2 = .1485$

$Y = 7.0020 - 0.0349d + 0.00004320d^2$

Welwitschiapites virgatus Deak 1963

Webb No. 1: $R^2 = .0712$

$Y = 10.0988 + 0.00000070d^3 + 0.0211s$

Boykin No. 2: No prediction equation.

Infraturma MONOCOLPITI (Wodehouse 1935)

Iversen and Troels-Smith 1950

Webb No. 1: $R^2 = .1906$

$Y = -3.6420 + 0.0218d + 0.4158s$

Boykin No. 2: No prediction equation.

Palmaepollenites tranquillus (R. Potonié 1934) R. Potonie 1951

Webb No. 1: $R^2 = .2703$

$Y = 5.2519 - 0.0311d + 0.00004736d^2$

Boykin No. 2: $R^2 = .3244$

$Y = 81.7475 - 0.7328d + 0.00211946d^2 - 0.000001958d^3$

Palmaepollenites ?

Webb No. 1: $r^2 = .1068$

$Y = 0.6349 + 0.00001315d^2$

Boykin No. 2: $R^2 = .1417$

$Y = -108.3457 + 0.9369d - 0.00256213d^2 + 0.000002278d^3$

Cycadopites nitidus (Balme 1957) nov. comb.

Webb No. 1: $R^2 = .1718$

$Y = -1.8827 + 0.00001210d^2 + 8.6603m + 0.5017s$

Boykin No. 2: $r^2 = .0942$

$Y = 3.8788 - 0.00001108d^2$

Liliacidites dividuus (Pierce 1961) Brenner 1963

Webb No. 1: $R^2 = .2171$

$Y = -3.1703 + 0.0535d - 0.00021586d^2 + 0.000000253d^3$

Boykin No. 2: $R^2 = .1303$

$Y = 11.0993 - 0.0553d + 0.00006845d^2$

Monosulcites chaloneri Brenner 1963

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .1280$

$Y = 21.9896 - 0.1033d + 0.00012112d^2$

Infraturma TRIPTYCHITI Naumova 1937

Webb No. 1: $R^2 = .4509$

$Y = -33.1804 + 0.00106015d^2 - 0.000001585d^3 + 3.7273s$

Boykin No. 2: $R^2 = .0907$

$Y = 61.6879 - 0.00058862d^2 + 0.000001076d^3$

Genus Tricolpopollenites Pflug and Thomson in Thomson and Pflug 1953

Webb No. 1: $R^2 = .4071$

$Y = -42.0925 + 0.1874d - 0.000000322d^3 + 35.8534m + 2.4921s$

Boykin No. 2: $R^2 = .0500$

$Y = 38.2504 - 0.00037812d^2 + 0.000000687d^3$

Tricolpopollenites parmularius (R. Potonié 1934) Thomson and Pflug 1953

Webb No. 1: $R^2 = .1403$

$Y = 4.0622 - 0.0498d + 0.00017074d^2 - 0.000000170d^3 + 0.1703s$

Boykin No. 2: $R^2 = .1690$

$Y = 59.5824 - 0.5373d + 0.00156199d^2 - 0.000001462d^3 + 9.5721m$

Tricolpopollenites retiformis Pflug and Thomson in Thomson and Pflug 1953

Webb No. 1: $R^2 = .1946$

$Y = 6.7997 - 0.0257d + 0.000000067d^3$

Boykin No. 2: $R^2 = .1049$

$Y = 1.3136 + 0.000000017d^3 - 9.9781m$

Tricolpopollenites minutus Brenner 1963

Webb No. 1: $R^2 = .1752$

$$Y = -0.7758 + 0.00023263d^2 - 0.000000342d^3$$

Boykin No. 2: $R^2 = .1330$

$$Y = 37.2121 - 0.00050263d^2 + 0.000000863d^3$$

Tricolpopollenites parvulus Groot and Penny 1960

Webb No. 1: $R^2 = .4080$

$$Y = 9.0525 - 0.1398d + 0.00057122d^2 - 0.000000633d^3 + 0.3792s$$

Boykin No. 2: $R^2 = .1695$

$$Y = -157.5528 + 1.3994d - 0.00388596d^2 + 0.000003535d^3 - 24.9799m$$

Tricolpopollenites elongatus Groot and Groot 1962

Webb No. 1: $R^2 = .0547$

$$Y = -0.0721 + 0.00000414d^3 + 0.0986s$$

Boykin No. 2: $R^2 = .0789$

$$Y = 3.3199 - 0.00006081d^2 + 0.000000110d^3$$

Genus Retitricolpites van der Hammen 1956

Webb No. 1: $R^2 = .6732$

$$Y = -23.4311 + 0.2992d - 0.00116105d^2 + 0.000001422d^3$$

Boykin No. 2: $R^2 = .4568$

$$Y = 175.5672 - 1.5770d + 0.00456014d^2 - 0.000004229d^3 + 22.3669m$$

Retitricolpites virgeus (Groot, Penny and Groot 1961)
Brenner 1963

Webb No. 1: No prediction equation.

Boykin No. 2: $r^2 = .0669$

$Y = 0.9034 - 0.0021d$

Retitricolpites cf. R. georgensis Brenner 1963

Webb No. 1: $R^2 = .6321$

$Y = -7.3353 + 0.1349d - 0.00064490d^2 + 0.000000910d^3$

Boykin No. 2: $R^2 = .4853$

$Y = 173.1463 - 1.5627d + 0.00453079d^2 - 0.000004208d^3 + 22.1672m$

Genus Tricolpites Erdtman 1947 ex Couper 1953
emend. R. Potonié 1960

Webb No. 1: $R^2 = .3424$

$Y = -14.1768 + 0.0864d - 0.00008660d^2 + 0.7161s$

Boykin No. 2: $r^2 = .0424$

$Y = 8.2297 + 0.2604s$

Tricolpites microreticulatus
Belsky, Boltenhagen and R. Potonie 1965

Webb No. 1: $R^2 = .2538$

$Y = 9.1327 - 0.0998d + 0.00034682d^2 - 0.000000337d^3$

Boykin No. 2: $R^2 = .1158$

$Y = -73.1392 + 0.6256d - 0.00167382d^2 + 0.000001466d^3 + 0.1650s$

Tricolpites tienabaensis Jardiné and Magloire 1965

Webb No. 1: $R^2 = .1838$

$Y = -2.4572 + 0.0414d - 0.00016301d^2 + 0.000000186d^3$

Boykin No. 2: No prediction equation.

Tricolpites wilsonii Kimyai 1966

Webb No. 1: $r^2 = .0759$

$Y = 0.3280 + 0.1409s$

Boykin No. 2: No prediction equation.

Tricolpites spp.

Webb No. 1: $R^2 = .2366$

$Y = -3.2757 + 0.000115388d^2 - 0.000000183d^3 + 0.5036s$

Boykin No. 2: $R^2 = .1410$

$Y = 9.1601 - 0.0136d$

Genus Latipollis Krutzsch 1959

Webb No. 1: $R^2 = .2772$

$Y = 36.2904 - 0.5095d + 0.00203081d^2 - 0.0000023328d^3 + 1.1086s$

Boykin No. 2: $R^2 = .1908$

$Y = 17.1829 - 0.00031586d^2 + 0.000000561d^3 - 13.0960m$

Latipollis normis Krutzsch 1959

Webb No. 1: $R^2 = .2554$

$Y = 15.9177 - 0.2142d + 0.00083566d^2 - 0.000000950d^3 + 0.4371s$

Boykin No. 2: $R^2 = .0970$

$Y = 4.8241 - 0.00009708d^2 + 0.000000176d^3$

Latipollis latis Krutzsch 1959

Webb No. 1: $R^2 = .2425$

$Y = 10.7834 - 0.1723d + 0.00074946d^2 - 0.000000909d^3 + 0.2643s$

Boykin No. 2: $R^2 = .2802$

$Y = 8.2000 - 0.00016038d^2 + 0.000000276d^3$

Latipollis verrucosus Groot and Groot 1962

Webb No. 1: $R^2 = .1988$

$Y = 9.9326 - 0.1348d + 0.00051442d^2 - 0.000000559d^3 + 0.4382s$

Boykin No. 2: No prediction equation.

Infraturma PTYCHOTRIPORITI Naumova 1937

Webb No. 1: $r^2 = .1031$

$Y = 2.5351 + 0.00003435d^2$

Boykin No. 2: $R^2 = .1452$

$Y = 42.8111 - 0.1702d + 0.00024396d^2 - 42.3539m - 0.3219s$

Genus Tricolporopollenites Pflug 1952

ex Thomson and Pflug 1953

Webb No. 1: $r^2 = .1484$

$Y = 1.5322 + 0.00003719d^2$

Boykin No. 2: $R^2 = .1345$

$Y = 36.9041 - 0.1586d + 0.00023409d^2 - 33.9271m$

Tricolporopollenites cf. T. aliquantulus Hedlund 1966

Webb No. 1: $r^2 = .0721$

$Y = 0.6766 + 0.00001162d^2$

Boykin No. 2: $R^2 = .2337$

$Y = 2.9191 + 0.000000035d^3 - 14.1826m - 0.2033s$

Tricolporopollenites sp. 1

Webb No. 1: $R^2 = .2143$

$Y = 4.8489 + 0.00002243d^2 - 18.0602m - 0.5654s$

Boykin No. 2: $R^2 = .1422$

$Y = 33.6537 - 0.1425d + 0.00018710d^2 - 22.2186m$

Tricolporopollenites sp. 2

Webb No. 1: $R^2 = .1836$

$Y = 4.3586 - 0.0463d + 0.00015256d^2 - 0.000000153d^3$

Boykin No. 2: $R^2 = .1487$

$Y = 0.1173 + 0.00000351d^2 - 3.9191m$

Psilatricolporites prolatus Pierce 1961

Webb No. 1: $R^2 = .2641$

$Y = 6.2265 - 0.0681d + 0.00021581d^2 - 0.000000211d^3$

$+ 0.2028s$

Boykin No. 2: No prediction equation.

Quercoidites ?

Webb No. 1: $r^2 = .0827$

$Y = 0.9116 - 0.00000545d^2$

Boykin No. 2: $R^2 = .1187$

$Y = 5.3858 - 0.0264d + 0.00003228d^2$

Unidentified Tricolporate Sporomorph 1

Webb No. 1: $R^2 = .1203$

$Y = -1.8320 - 0.0313d - 0.00012070d^2 + 0.000000133d^3$

Boykin No. 2: $R^2 = .1442$

$Y = 5.4613 - 0.0356d + 0.00005562d^2 + 2.9311m$

Unidentified Tricolporate Sporomorph 2

Webb No. 1: $R^2 = .1233$

$Y = 0.3064 - 0.0026d + 0.00000433d^2 + 0.0258s$

Boykin No. 2: No specimens assigned to this species were recorded from the Boykin core hole.

Unidentified Tricolporate Sporomorph 3

Webb No. 1: $R^2 = .2563$

$Y = 2.7586 - 0.0294d + 0.00009304d^2 - 0.000000092d^3 + 0.0387s$

Boykin No. 2: No prediction equation.

Infraturma TRIPORITI Naumova 1937

Webb No. 1: $R^2 = .1827$

$Y = 27.9452 - 0.3089d + 0.00108297d^2 - 0.0000011444d^3$

Boykin No. 2: $R^2 = .2065$

$$Y = 13.8440 - 0.0769d + 0.00010756d^2$$

Genus Sporopollis Pflug 1953

Webb No. 1: $R^2 = .2815$

$$Y = 22.2092 - 0.2419d + 0.00083819d^2 - 0.000000885d^3$$

Boykin No. 2: $R^2 = .1841$

$$Y = 10.5715 - 0.0594d + 0.00008400d^2$$

Sporopollis pseudosporites Pflug 1953

Webb No. 1: $R^2 = .1082$

$$Y = 0.2286 - 0.00001120d^2 + 0.000000029d^3$$

Boykin No. 2: $R^2 = .0797$

$$Y = 2.6716 - 0.0142d + 0.00001859d^2$$

Sporopollis sp. 1

Webb No. 1: $R^2 = .2636$

$$Y = 18.2648 - 0.2148d + 0.00078674d^2 - 0.000000878d^3$$

Boykin No. 2: $R^2 = .1710$

$$Y = 22.6295 - 0.1748d + 0.00043655d^2 - 0.000000349d^3$$

Sporopollis sp. 2

Webb No. 1: $R^2 = .1085$

$$Y = 4.8054 - 0.0562d + 0.00019508d^2 - 0.000000204d^3 + 0.0876s$$

Boykin No. 2: $R^2 = .2630$

$$Y = -17.6728 + 0.1833d - 0.00058570d^2 + 0.000000602d^3$$

Conclavipollis densilatus Kimyai 1966

Webb No. 1: $r^2 = .1094$

$Y = -0.7943 + 0.000000037d^3$

Boykin No. 2: $R^2 = .0946$

$Y = 1.0533 - 0.0059d + 0.0000081d^2$

Genus Complexiopollis Krutzsch 1959

Webb No. 1: $r^2 = .0934$

$Y = 0.0044 + 0.000000014d^3$

Boykin No. 2: $R^2 = .0987$

$Y = 0.8094 - 0.00001508d^2 + 0.000000027d^3 - 0.0162s$

Complexiopollis praetumescens Krutzsch 1959

Webb No. 1: $R^2 = .2853$

$Y = 16.1163 - 0.00052293d^2 + 0.000001131d^3$

Boykin No. 2: No prediction equation.

Complexiopollis sp.

Webb No. 1: $R^2 = .6465$

$Y = -5.2852 + 0.0854d - 0.00035786d^2 + 0.000000441d^3$

Boykin No. 2: No prediction equation

Triorites cf. T. edwardsii Cookson and Pike 1954

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Unidentified Triporate Sporomorph 1

Webb No. 1: No prediction equation.

Boykin No. 2: $R^2 = .0954$

$$Y = 1.3487 - 0.0078d + 0.00001119d^2$$

Turma JUGATES Erdtman 1943

Webb No. 1: $R^2 = .1064$

$$Y = -0.4088 + 0.00000758d^2 + 0.1134s$$

Boykin No. 2: $R^2 = .0847$

$$Y = -75.9314 + 0.6622d - 0.00183052d^2 + 0.000001652d^3$$

Unidentified Dyad Sporomorph 1

Webb No. 1: $R^2 = .1356$

$$Y = -7.3540 + 0.0801d - 0.00027322d^2 + 0.000000303d^3 + 0.0888s$$

Boykin No. 2: $R^2 = .1077$

$$Y = 3.5628 - 0.00005274d^2 + 0.000000083d^3$$

<u>Dicotetradites granulatus</u> Norton in Norton and Hall 1969

Webb No. 1: No prediction equation

Boykin No. 2: $R^2 = .4160$

$$Y = 0323.0271 + 2.5580d - 0.00661244d^2 + 0.000005613d^3$$

Unidentified Palynomorph 2

Webb No. 1: $R^2 = .2650$

$$Y = -2.4938 + 0.0419d - 0.00017119d^2 + 0.000000204d^3$$

Boykin No. 2: $r^2 = .2557$

$Y = -0.3211 + 5.9724m$

Genus Schizosporis Cookson and Dettmann 1960

Webb No. 1: $r^2 = .0534$

$Y = 0.0137 + 5.1778m$

Boykin No. 2: No prediction equation.

Schizosporis parvus Cookson and Dettmann 1960

Webb No. 1: $R^2 = .1926$

$Y = -0.6186 + 0.000000007d^3 + 5.9249m$

Boykin No. 2: No prediction equation.

Schizosporis majusculus Hedlund 1966

Webb No. 1: No prediction equation.

Boykin No. 2: No prediction equation.

Genus Hystrichosphaeridium Deflandre 1937
emend. Eisenack 1958

Webb No. 1: $R^2 = .1955$

$Y = -3.0363 + 0.00016516d^2 - 0.000000312d^3$

Boykin No. 2: $R^2 = .1579$

$Y = 1.5973 - 0.000000023d^3 + 7.0950m$

Hystrichosphaeridium tubiferum (Ehrenberg 1838)
Deflandre 1937

Webb No. 1: $R^2 = .4621$

$Y = 360.5918 - 3.6709d + 0.01230614d^2 - 0.00001352d^3 - 6.6178m$

Boykin No. 2: $r^2 = .1628$

$Y = -0.3748 + 14.9525m$

Hystrichosphaeridium sp.

Webb No. 1: $R^2 = .1801$

$Y = -10.0443 + 0.00032508d^2 - 0.000000618d^3$

Boykin No. 2: $r^2 = .0776$

$Y = 1.6675 - 0.0033d$

Unidentified Dinophyceae Cyst 1

Webb No. 1: $R^2 = .1672$

$Y = 43.4118 - 0.2172d + 0.00026994d^2$

Boykin No. 2: $R^2 = .3671$

$Y = 8.8188 - 0.00021733d^2 + 0.000000413d^3$

Genus Micrhystridium Deflandre 1937

emend. Downie and Sarjeant 1963

Webb No. 1: $R^2 = .1678$

$Y = -7.6419 + 0.00035058d^2 - 0.000000654d^3$

Boykin No. 2: $R^2 = .1620$

$Y = 2.6631 - 0.000000039d^3 + 16.6139m$

Micrhystridium piliferum Deflandre 1937

Webb No. 1: $r^2 = .1641$

$Y = -0.0099 + 0.1592s$

Boykin No. 2: $R^2 = .3316$

$$Y = 74.1809 - 0.6174d + 0.00168462d^2 - 0.000001515d^3 + 10.5640m$$

Micrhystridium fragile Deflandre 1947

Webb No. 1: $R^2 = .1932$

$$Y = -3.2119 + 0.00021399d^2 - 0.000000373d^3 - 0.7816s$$

Boykin No. 2: $R^2 = -3.5440 + 0.0192d - 0.000000055d^3$

Micrhystridium sp.

Webb No. 1: $R^2 = .3142$

$$Y = 112.2835 - 1.1085d + 0.00362684d^2 - 0.0000003811d^3 - 11.1263m$$

Boykin No. 2: $R^2 = .1387$

$$Y = -19.0870 + 0.1276d - 0.00019718d^2$$

Baltisphaeridium sp.

Webb No. 1: $R^2 = .1393$

$$Y = -21.5737 + 0.1360d - 0.00020241d^2$$

Boykin No. 2: $R^2 = .3233$

$$Y = 223.2905 - 2.1171d + 0.00658717d^2 - 0.000006749d^3 + 17.5356m$$

Metaleiofusa diagonalis Wall 1965

Webb No. 1: $R^2 = .1927$

$$Y = 86.8254 - 0.7991d + 0.00241209d^2 - 0.000002377d^3$$

Boykin No. 2: No prediction equation.

Unidentified Acritarch 1

Webb No. 1: $R^2 = .3110$

$$Y = 192.7069 - 1.9458d + 0.00646957d^2 - 0.000007070d^3$$

Boykin No. 2: $R^2 = .3385$

$$Y = 380.4211 - 3.2608d + 0.00927836d^2 - 0.000008769d^3 + 3.7338m$$

Unidentified Acritarch 2

Webb No. 1: $R^2 = .2406$

$$Y = 261.7790 - 2.4249d + 0.00743394d^2 - 0.000007552d^3 + 0.1169s$$

Boykin No. 2: $R^2 = .1302$

$$Y = 3.4999 - 0.0175d + 0.00002164d^2$$

Unidentified Acritarch 3

Webb No. 1: $R^2 = .3603$

$$Y = 252.3059 - 2.5641d + 0.00859411d^2 - 0.000009485d^3$$

Boykin No. 2: $R^2 = .3138$

$$Y = 3.9433 - 0.000131049d^2 + 0.000000288d^3$$

APPENDIX E

BINOMIAL TESTS OF SIGNIFICANCE PERFORMED ON MIOSPORE SPECIES WHICH WERE LITHOLOGICALLY CONTROLLED

The binomial test of significance is a nonparameteric test for use with nominal scale data. Under a true null hypothesis, the test statistic follows the binomial distribution, according to the expression:

$$\binom{N}{x} P^N \quad Q^{(N-x)}$$

where,

N = the total number of observations,

x = the number of observations in the smaller of the two groups,

P = the probability of "success" (the probability that an observation will fall into one of the groups),

Q = the probability of "failure" (= 1-P).

When N is larger than 20, it can be shown that the binomial approaches the normal distribution, with a mean of NP, and a variance of NPQ.

H_0: The probability that a species displays a frequency of occurrence which increases with a unit increase in sorting coefficient = the probability that a species displays a frequency of occurrence which decreases with a unit increase in sorting coefficient.

α = .05, two-tailed test.

N = 41

x = 6 = the number of species that decreased.

P = Q = .5

Z approximation:

$$Z = \frac{(x + .5) - NP}{NPQ}$$

$$Z = \frac{(6 + .5) - (41)(.5)}{(41)(.5)(.5)}$$

$$Z = \frac{6.5 - 20.5}{10.25}$$

$$Z = \frac{-14}{3.20}$$

$$Z = -4.381$$

$P(Z \leq -4.381) = .0000059$

As .0000059 < .05, the null hypothesis is rejected and it is concluded that more species increase in abundance with a unit increase in sorting coefficient than decrease in abundance with a unit increase in sorting coefficient.

H_0: The probability that a species displays a frequency of occurrence which <u>increases</u> with a 1 mm increase in median grain size = the probability that a species displays a frequency of occurrence which <u>decreases</u> with a 1 mm increase in median grain size.

α = .05, two-tailed test.

N = 29

x = 12 = the number of species that decreased.

P = Q = .5

Z approximation:

$$Z = \frac{(x + .5) - NP}{NPQ}$$

$$Z = \frac{(12 + .5) - (29)(.5)}{(29)(.5)(.5)}$$

$$Z = \frac{(12.5 - 14.5)}{7.25}$$

$$Z = \frac{-2}{2.6926}$$

$$Z = -.7428$$

$P(Z \leq -.7428) = .229$

As .229 $>$ .05, the null hypothesis is not rejected, and it is concluded that the probability of a species to display a frequency of occurrence which increases with a 1 mm increase in median grain size = the probability that a species will display a decrease in frequency of occurrence with a 1 mm increase in median grain size.

VITAE

Raymond Anthony Christopher was born on October 11, 1943, in Brooklyn, New York, the second son of Mr. and Mrs. Harold Christopher. His primary and secondary school education was received through the New York City Public School System, which graduated him from Bayside High School in June, 1960. Mr. Christopher studied architecture at Illinois Institute of Technology from September, 1960 to June, 1962, when he transferred to the University of Rhode Island. He received a Bachelor of Science degree in June, 1965, majoring in Geology, and remained at the University to study under the direction of Eugene J. Tynan. He was awarded a Master of Science degree in June, 1967.

In August, 1965, Mr. Christopher married Margaret K. Brosemer of Valhalla, New York. They are the parents of one son, Andrew.

Mr. Christopher is a member of the American Association of Stratigraphic Palynologists and the Society of Economic Paleontologists and Mineralogists.

EXAMINATION AND THESIS REPORT

Candidate: Raymond Anthony Christopher

Major Field: Areal Geology

Title of Thesis: The Application of Statistical Techniques to the Palynofloral Analysis of the Coker Formation (Upper Cretaceous), Western Alabama.

Approved:

Major Professor and Chairman

Dean of the Graduate School

EXAMINING COMMITTEE:

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Date of Examination:

January 19, 1971